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July 1979

**Practical Shipbuilding Standards
for Surface Preparation and Coatings**

**U.S. Department of Commerce
Maritime Administration**

**in cooperation with
Avondale Shipyards, Inc.
New Orleans, Louisiana**

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AVONDALE SHIPYARDS, INC.

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WESTERN UNION TELEX:

ENGINEERING AVONENG NLN 58-245
PURCHASING AVONPUR NLN 58-246

January 17, 1980

Dear Sir:

Subject: National Shipbuilding Reports

Reference: (1) Practical shipbuilding Standards for
Surface Preparation and Coatings
(2) Marine Coatings Performance for.
Different Ship Areas, Vol. I and II

The subject reports are enclosed for your information. The national Shipbuilding Research Program is a rest-shared program of the Maritime Administration and the shipbuilding industry dedicated to the enhancement of manufacturing technology and the reduction of ship production costs.

The reference programs are a cost shared effort of Avondale shipyards, Inc. The investigation WAS performed by Offshore Power Systems, Mr. Benjamin S. Fultz, program Manager.

The executive summaries will provide you with a concise synopsis of the investigations.

Reference (1) Program resulted in the following:

Development of a proposed Shipbuilding Standard for Surface preparation and Coatings

Development of a Standard "Paints and Coatings Product/Procedure Data sheet"

Identified the need for preconstruction conferences between the owner, applicator and paint suppliers

This conference would result in the choice of painting systems that would be Comparable with the shipyard's climatic conditions and manufacturing methodology, resulting in the reduction in application cost and the reduction of coating failures.

The objective of the reference (2) Project was to establish methods to reduce ship construction costs by improving the paint selection system. Toward this end, the following results were achieved:

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Establishment of a computer program of paint service histories which demonstrate that valid conclusions can be reached as to which generic paint type is best for a specified area of this ship.

Support by laboratory testing of performance trends of the computer program analysis

Demonstration by laboratory testing that careful evaluation of paint suppliers is necessary

Indications that careful selection of laboratory test methods and evaluation parameters, to duplicate service conditions, can serve as a screening method for candidate paint(s)

Establishment of craft interface and premature area release for painting Prior to compartment completion. That is, poor paint planning and scheduling is the major cause of inordinately high ship painting costs.

If the principles identified within the body of this report are assimilated by the marine industry; many dollars in improved ship paint performance will be realized. shipbuilders will benefit in two (2) ways:

Less dollars expended at guarantee survey time due to improved paint performance (fewer failures)

Reduction in the probability of a catastrophic paint failure during vessel construction

These programs have identified high cost problem areas and have recommended procedures that, when implemented, will result in meaningful cost savings. Effective implementation is dependent upon the response of the individual yards and the cooperative effort of the industry.

Sincerely yours,

, AVONDALE SHIPYARDS, INC.



J.W. Peart
Program Manager

JWP/mag

Attachments

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FOREWORD

This research project was performed under the National Shipbuilding Research Program. The project, as part of this program, is a cooperative cost shared effort between the Maritime Administration, Avondale Shipyards, Inc. and Offshore Power Systems, a wholly owned Westinghouse subsidiary. The overall objective of the program is improved productivity and, therefore, reduced shipbuilding costs to meet the lower Construction Differential Subsidy rate goals of the Merchant Marine Act of 1970.

The studies have been undertaken with this goal in mind, and have followed closely the project outline approved by the Society of Naval Architects and Marine Engineers' (SNAME) Ship Production Committee. The research effort for the project was assigned, by subcontract, to Offshore Power Systems.

Mr. Benjamin S. Fultz, Mr. P.J. Hawkins and Mr. Dave Sealander, of Offshore Power Systems, served as Project Manager and Senior Engineers respectively. On behalf of Avondale Shipyards, Inc., Mr. John Peart was the R & D Project Manager responsible for technical direction and the editing and publishing of this report. Program definition and guidance was provided by the members of the 023-1 Surface Preparation Coatings Committee of SNAME, Mr. C.J. Starkenburg, Avondale Shipyards, Inc., Chairman.

Special thanks is also extended to Mr. William Arbiter, who reviewed the draft of this report and offered valuable criticism. Also, we wish to acknowledge the support of Mr. Jack Carvey and Mr. Robert Schaffran, of the Maritime Administration, and the contributions of the following corporations:

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Mobile Paint Manufacturing Company, Mobile, Alabama

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EXECUTIVE SUMMARY

It is a generally accepted fact that between twelve and seventeen percent of all new commercial ship construction dollars are spent in initial ship painting. This means that the marine industry is probably spending upwards of five times more on painting than it should. This expenditure represents tens of millions of dollars being needlessly wasted.

One of the causes for this needless expenditure of dollars is the lack of communication between the various facets of the marine industry — that is the owner, builder, and supplier. This study is an attempt to rectify this wasteful situation.

Three positive results were obtained from this Research and Development Project, namely:

1. Development of a proposed Practical Shipbuilding Standard for Surface Preparation and Coatings.
2. Development of a standard "Paints and Coatings Product/Procedure Data Sheet."
3. Identification of the need for preconstruction conferences consisting of representatives from the shipyard production and technical sections, the owner's representatives and the paint/coating supplier or suppliers.

Steps are presently underway to have the Standard Data Sheet and pre-construction conference ideas accepted by the marine industry. The new proposed Section 14 (Painting and Cementing) of the Maritime Administration Standard Specifications for Merchant Ship Construction contains the requirement for both of these items. ASTM F-25, which is the new shipbuilding consensus standards group, will propose that the Data Sheet be accepted as a new ASTM Standard. Each shipyard can insure that the "Paints and Coatings Product/Procedure Data Sheet" is accepted by making it a requirement of, and a part of all bid responses, during the course of new ship procurement activities. This point is covered in detail in Section 1 of this report.

In conclusion, it can be said that this study has been, and will be, extremely valuable in identifying and solving shipbuilding paints and coatings problems. This will lead to reduced ship construction costs.

LIST OF FIGURES

- 2.1 Shipbuilder Question Responses
- 2.2 Standards and Specifications Currently in Use in American Shipyards as Determined from Questionnaires
- 2.3 Comparison of Various National Abrasive Blasting Standards.

SECTION 1

Conclusion

1. CONCLUSION

1.1 Cost Savings In Standards Utilization

It has long been apparent to knowledgeable persons in the field of coatings for marine structures, that a three way interest exists. Coating suppliers market materials which represent the best economic advantage to their particular company; i.e., some companies specialize in zinc rich paints, others in epoxies, etc. The shipowner is primarily interested in in-service performance, not truly understanding or caring for the problems of application under adverse shipyard conditions. The shipbuilder wants to be able to apply the specified coating system with available resources without delays. In reality, all are desirous of achieving the best coating system based on the lowest life cycle cost.

This apparent lack of empathy among the different facets of the shipbuilding industry is primarily due to lack of standardization and a common baseline of communication. The end result of this misunderstanding is added ship production costs.

Coating systems must be designed and qualified as totally integrated, all encompassing systems. The surface condition of the substance material, the primer, top coats and their application environment must be considered in the choice of the system. The coating system must be fully qualified by the coating suppliers, shipowners, and shipyard applicators, with constraints established on all materials and procedures to make the coating systems dependable, producible, economical and long lasting with minimum maintenance.

It was the objective of this research and development program to establish workable, economical standards governing the preparation and characterization of prepared surfaces, the application of coating systems, and the standardization of materials. These standards must represent the consensus of the requirements of all sections of the coatings community and must ultimately be universally applied and enforced. The final acceptance of a set of practical shipbuilding standards for surface preparation and coatings will provide a common baseline of communication which will result in cost savings and increased credibility among all persons concerned.

1.2 Use of Paints and Coatings

Product/Procedure Data Sheet

An important result of this study is the "Paints and Coatings Product/Procedure Data Sheet" contained in Section 3 of this report. This data sheet, if properly used, can and will save countless dollars by reducing the normal ambiguities surrounding paint application instructions. All the information needed by an applicator to apply a given material is included in this two page data sheet - front and back. At present, each paint supplier has a different format for presenting application instructions, with varying degrees of completeness. Some are so detailed as to be confusing. Others are so incomplete as to leave the user completely free to do anything he likes, usually resulting in premature failure.

Another potential use of the data sheet is pre-election technical evaluation of candidate paint materials on new contracts. For example, *during the initial request for quotations to paint suppliers, the completion of the "Paints and Coatings Product/Procedure Data Sheet" would be made a condition of the response.* The completed data sheets would then be submitted to the shipyard as a part of and included within the bid response. Copies of all candidate material data sheets would then be forwarded to the production paint department and the engineering department for review prior to final paint/coating selection. The engineering department would review the data sheet to insure that the proposed materials meet the technical requirements of the building contract. The production paint department would review the data sheets to insure that the proposed materials are compatible with the manufacturing scheme and the environmental constraints of the facility. *At the completion of the technical reviews, a meeting between engineering, production paint, procurement (purchasing) and each supplier would be scheduled.* The sole purpose of these meetings would be to identify, discuss and solve technical problems. Data Sheets could possibly be revised by the supplier at that time or new materials proposed. In any case, the "Paints and Coatings Product/Procedure Data Sheet" would form the basis of the discussion. Each product would be evaluated on an equal basis.

Following technical negotiations, the final paint/coatings selection would then be based on the low bidder who met the technical requirements

of both production and engineering. The cost comparison should be based on actual coverage per square foot, taking into account special application and/or surface preparation requirements. The coverage rate calculated from information contained in Section III(a) would be used. The true cost of a paint system includes the actual coverage rate of the material, application cost, environmental control cost, and surface preparation cost (initial and touch-up).

Following final supplier selection the revised or updated "Paints and Coatings Product/Procedure Data Sheet" could form the basis of improved quality control.

The completed Data Sheet would become contractually binding to both the shipyard and coatings supplier. If the material could not be applied as defined in the data sheet, this would form the basis for financial responsibility on the part of the coatings supplier. Within the shipyard, certain attributes contained on the data sheet could be checked and verified by the builder's quality control/assurance department.

product/Procedure sheets should be issued to the lowest level of production supervision on a controlled basis.

As can be seen from the discussion above, the "paints and Coatings Product/Procedure Data Sheet" can, and should, become the focal point for initial material selection, complete concise instructions for paint craft personnel, and a means of control by quality personnel.

1.3 Continued Research and Development

This project attempted to establish a set of reasonable, practical surface preparation and coatings standards. As the project progressed, the enormity of this task became more apparent. The technical aspects of paints and coatings systems encompass a wide variety of engineering and scientific disciplines while, in many respects, they still maintain the status of an "art". This report is a "first step" attempt to gather together existing standards and information which can be of use to the shipbuilder. The primary benefits derived from this study are the creation of the Paints & Coatings Product/Procedure Data Sheet and the

stimulation of scientific thought in identifying problem areas which need further investigation. As originally envisioned, a Phase II project would be necessary to further develop, coordinate and assure acceptance of paints and coatings standards by the shipbuilding community. Based on the results of this project, a Phase II is warranted and should be initiated. Additional areas needing standards investigation and definition are:

1. Abrasives - Degree of purity, hardness, size, etc.
2. Volume Solids Determination
3. Definition of Sharp Edges
4. Improved Visual Standards for Surface Preparation
5. Quality Control Receipt Inspection Procedures for Protective Coatings (Paint) Materials.
6. Film Thickness Measurement
7. Generic Coatings Definitions
8. Touch-up Surface Preparation Standards - Both Visual and Written
9. Definitions and Test for Dry and Cure and the Difference Between Each
10. Definition of and Measurement of Surface Roughness (Profile)
11. Development of a True Ballast Tank Qualification and Test Procedure
12. Development of Protective Coatings (Paint) Quality Assurance Manual for Shipbuilding
13. Test for and Definition of Contamination of Substrate Prior to Protective Coatings (Paint) Application
14. Develop Standard Paint System for Vendor Supplied Equipment

In January 1978, a meeting was held at ASTM headquarters to develop voluntary consensus standards for the Shipbuilding Industry. Since that time, the committee has been organized as F-25. Under F-25 there is a subcommittee with the responsibility of developing paints and coatings standards. This forum offers an ideal method to present, and have accepted, the standards developed under this program and future programs.

SECTION 2

Project Plan of

Action and Results

2. PROJECT PLAN OF ACTION AND RESULTS

2.1 Objective

The overall objective of this project is the development of a set of accepted standards for shipbuilding surface preparation and coating.

1. Phase 1—

Phase I encompassed an in-depth survey of current practices within American and foreign shipyards, American industry, and various government agencies. Existing specifications, standards, and regulations from all available sources were analyzed and a tentative draft standard formulated. The end result of this effort is contained in Section 4 of this report.

2. Phase II -

A Phase II effort will be required for the coordination and acceptance of the proposed standards by the shipbuilding industry.

2.2 General Approach

Phase I was broken into four distinct tasks. These tasks and the results obtained from each are discussed in the paragraphs which follow.

2.3 Determination of Surface Preparation and Coating Practices Utilized by U.S. and Foreign Shipyards

Immediately after the project startup, a questionnaire was formulated and sent out to selected United States and foreign shipyards. The purpose of this questionnaire was to poll shipyards as to which surface preparation and coatings standards are presently being used. Annex A contains a summary of the responses. Nineteen companies responded to the request for information. All major shipyards were represented and numerous smaller yards

responded. Below is a synopsis of the responses by geographical area:

North East Atlantic	3
Mid Atlantic	2
Gulf	5
North West Pacific	3
South West Pacific	2
Inland Waterways	3
Great Lakes	1

Question 25 on this questionnaire concerned Paints and Coatings Specifications and Standards. Listed below is a recapitulation of all shipbuilder responses.

FIGURE 2.1 Shipbuilder Questionnaire Responses

1. Are paints/coatings specifications complete?	13 YES	6 NO
2. Are paints/coatings specifications overly restrictive?	10 YES	9 NO
3. Are paints/coatings standards used?	13 YES	6 NO
4. Are specifications available to craft personnel?	10 YES	9 NO
5. Do specifications contain production sequence requirements which cannot be followed?	3 YES	16 NO

No clear majority of those companies responding felt that the present paints and coatings specifications were complete. In fact, detailed evaluation of those major companies who do primarily commercial work revealed that the consensus of opinion was that complete specifications do not exist.

In addition to being queried about the adequacy of existing specifications, inquiries were also directed at which specific Standards and/or Specifications were available and being used. A response summary is listed in Figure 2.2.

I Standard/Specification	USED	NOT USED
1. Steel Structures Painting Council Surface Preparation Standards (SSPC)	15	4
2. National Association of Corrosion Engineers (NACE) Visual Standards for Blast-Cleaned Steel	7	12
3. National Bureau of Standards (NBS) Certified Coating Thickness Calibration Standards	9	10
4. Steel Structures Painting Council Paint Thickness Measurement SSPC-PA 2-73T	13	6

5. The Society of Naval Architects and Marine Engineers' Abrasive Blasting Guide for Aged or Coated Steel	4	15
6. Japanese Standard for the Preparation of Steel Surfaces Prior to Painting	1	18
7. Swedish Pictorial Surface Preparation Standards for Painting Steel Surfaces	9	10
8. American Society for Testing and Materials (ASTM) D2697-73, "Volume Non-volatile Matter in Clear or Pigmented Coatings"	5	14

FIGURE 2.2: Standards and Specifications Currently in Use in American Shipyards as Determined from Questionnaire

In addition to polling shipyards, questionnaires were also sent to marine coating suppliers and various governmental agencies. An extensive literature search to include National Technical Information Service (NTIS) and Maritime Research Information Service (MRIS) computer searches were also performed. The bibliography in section 5 of this report contains a listing of standards and specifications identified as a result in this effort. paragraph 2.4 contains a detailed discussion of each source examined for possible inclusion in the proposed shipbuilding paints and coatings standard.

2.4 Scope of Standards to be Developed

2.4.1 Definition of Standards

At this point it may be advisable to define what is meant by the term "Standard". As used by the American Society for Testing and Materials (ASTM), "Standards comprise those test methods, definitions, recommended practices, classifications, and specifications that have been formally adopted by the Society".

Many people confuse the terms standard and specification. ASTM defines, "A specification is a precise statement of a set of requirements to be satisfied by a material, product, system, or service, indicating, whenever appropriate, the procedures by means of which it may be determined whether the requirements given are satisfied."

This report will follow the definitions of "standard" and "specification" as used by ASTM. Therefore, the Standards developed will include both recommended practices and precise specifications. These standards can then be used by interested parties in part or as a whole.

2.4.2 Analysis of Existing Standards

This task was primarily an analysis of existing regulations and their adaptability to shipbuilding. The paragraphs which follow will give a short synopsis of this review and analysis.

protective coating (paint) standards are generally broken into two categories, The first is cleaning or preparing the substrate prior to application of coatings, and the second concerns the control of the protective coating materials.

At least seven different countries have issued surface preparation specifications. These are the United States, United Kingdom, Japan, Holland, West Germany, France and Sweden. The American, British, Japanese and Swedish Standards are discussed below. Almost every country has material specifications.

2.4.2.1 AMERICAN STANDARDS

2.4.2.1.1 Steel Structures Painting Council

The Steel Structures Painting Council's Volume 2 of the Steel Structures Painting Manual (34) contains System and Specifications for both steel surface preparation and protective coatings materials. The surface preparation specifications define surface conditions and cleanliness requirements regardless of the initial condition of the steel, that is if it is new steel from the steel mill, preprinted, or rusted to various degrees. Each specification contains "Scope", "Definition", "procedure", "Safety Precautions" and "Inspection" requirements. No photographs or pictures are included directly in the specifications. Steel Structures Painting Council did approve a visual standard prepared and issued by the Swedish Standards Institution under the nomenclature of "SSPC Visual Standard SSPC-VisL67T". This standard

will be discussed later. The SSPC standards are probably the most universally accepted surface preparation standard, not only in America, but also internationally. The primary limitation of these specifications concern the interpretation of the verbiage and the equating of verbiage to visual interpretation, especially on heavily pitted old steel. These surface preparation standards are presently being rewritten.

The primary change will be a simplification of the written specification with many present requirements being moved to a section of the standard called a "Guide". In the materials area, SSPC published many protective coating specifications. Volume 2 of their manual contains numerous generic types of paint, ranging from "Oil Based Systems (for Weather Exposed Wire-Brushed Steel)" to "Inorganic Zinc". Two new specifications for Inorganic Zinc are currently being prepared and reviewed. There is some move afoot to dilute the total zinc content requirements of these materials. Hopefully this will not happen.

SSPC also published a standard method which concerns the "Measurement of Dry Paint Thickness with Magnetic Gages", (33). Two types of measurement gages are covered by this specification, namely Pull-Off Gages and Fixed Probe Gages. The method takes into account the profile of the substrate and establishes a minimum number of measurements per given surface area.

2.4.2.1.2 National Association of Corrosion Engineers

The National Association of Corrosion Engineers (NACE) has issued many standards on surface preparation and protective coatings. The Bibliography in Section 6 bares witness to this fact. In this author's opinion, the most valuable specifications are the Visual Standards for Surface Preparation (39, 40, 41). These standards are actual abrasive blasted steel surfaces prepared to four different degrees of cleanliness by three different techniques, namely centrifugally blast cleaned with steel shot, centrifugally blast cleaned with grit, and airblast cleaned with sand abrasives. The primary drawback to this standard is the fact that relatively new steel was used to prepare the representation specimens.

Another NACE Standard which deserves mention is RP-01-72 (37), "Surface Preparation of Steel and Other Hard Materials by Water Blasting Prior to Coating or Recrating". This standard allows the use of high pressure water with and without sand. The degree of cleanliness after blasting is not defined; however, cleaning rates are given.

NACE Standard RP-01-78, "Design, Fabrication, and Surface Finish of Metal Tanks and Vessels to be Lined for Chemical Immersion Service" (10) lists design, fabrication and surface finish requirements for tanks and vessels used under severe service conditions to preclude corrosion. One interesting point covered by this standard concerns sharp edges. Paragraph 4.1 states "Sharp edges and fillets shall be ground to a smooth radius of at least 0.3 cm (1/8 inch) with 0.6 cm (1/4 inch) preferred".

NACE also publishes many articles concerning paint materials (44, 46, 49, 54, 59, 60, 61, 62, 63).

2.4.2.1.3 The Society of Naval Architects & Marine Engineers (SNAME)

SNAME published an "Abrasive Blasting Guide for Aged or Coated Steel Surfaces" (1) which was prepared by Panel O-23 (Ship's Paints) of the Ship Technical Operations Committee in cooperation with the Naval Applied Science Laboratory and the Naval Ship Systems Command.

This Guide includes a series of black and white and color photographs depicting both painted and unpainted steel exposed for a time period to a marine environment and illustrating the appearance of the surfaces which result when abrasive blasted to various grades. The blasting grades are directly related to SSPC specifications.

Four black and white photographs are included. These photographs are blurred with the areas calculated and depicted approximately as they would appear following blasting.

Nine color photographs are also included. Each photograph is a step-up graduation of surface condition before and after blast cleaning. The original condition is at the top of the page with increasing degrees of cleanliness progressing to the bottom of the page. Both representations for mild steel and high tensile steel are included. This guide is an excellent source document, but just as with other pictorial standards, the one limiting factor is resolution and color of photographs.

2.4.2.1.4 American Society for Testing and Materials (ASTM)

Part 27, "Paint-Tests for Formulated Products and Applied Coatings" (2) contains all of the ASTM standards issued relative to paint. These standards cover test methods, surface preparation, film thickness measurements, performance evaluation and paint ingredients. Many of these standards were used to define properties included in the standard developed during this program.

2.4.2.1.5 Others

Many other American standards exist. The Bibliography contained in Section 6 of this report should be reviewed.

2.4.2.2 BRITISH STANDARDS

The British have issued three primary documents concerning surface preparation and protective coatings. These are discussed below.

2.4.2.2.1 Code of Practice for Cleaning and Preparation of Metal Surfaces (CP3012:1972) (6)

This specification deals mainly with chemical and solvent cleaning methods and procedures to include formula and recipes for copper, aluminum, steel, stainless steel, etc. The major sections of this specification are listed below:

1. General Cleaning Where No Subsequent Coatings Are to be Applied.
2. Preparation Prior to the Application of Surface Coatings
3. Methods (Cleaning and Preparation Methods Referred to in Sections 1 and 2)

Section 2 is further subdivided into:

1. Electrodeposited Metal Coatings
2. Electroless Metal Coatings
3. Conversion Coatings
4. Anodic Oxidation Coatings
5. Hot Dipped Coatings
6. Sprayed Metal Coatings

7. Diffusion Coatings

8. Vitreous and Porcelain Enamel Coatings
9. Paint Coatings on Non-Ferrous Metals

Method d, Section 3 concerns abrasive cleaning. This is a very general treatment of blasting requirements. The recommended grit size is Grade G17 of BS 2451 or larger. It also states that "The process is unsuitable for thin material or where a fine surface finish is required."

2.4.2.2.2 Specification for Surface Finish of Blast-Cleaned Steel for Painting, British Standard 4232:1967 (30)

The following paragraphs are excerpts from the foreword of the specification:

"This British Standard was prepared under the authority of the Pigments, Paints and Varnishes Industry Standards Committee at the request of the British Association of Corrosion Engineers. It is based on draft specifications for qualities of blastcleaning proposed by an expert committee of the BACE, to whom due acknowledgement is made. It is not intended to cover wet methods of blast cleaning".

"The quality levels defined in this British Standard have been selected so as to be roughly equivalent to those defined in the internationally standards of the Steel Structures Painting Council and the Swedish Standards Organization".

Figure 2.3 compares each standard.

British Standard	Steel Structures Paint Council	Swedish Standard
First Quality	White Metal (SSPC SP5)	SA3
Second Quality	Near White Metal (SSPC SP10)	SA2.5
Third Quality	Commercial (SSPC SP6)	SA2

FIGURE 2.3: Comparison of Various National Abrasive Blasting Standards

The British Standard covers dry abrasive blasting of new steel, weathered steel and prior coated steels. The degree, or quality, of the resultant surface is defined in terms of cleanliness and roughness. It goes onto state that "There are no simple precise means of measuring these characteristics but the first (cleanliness) can be estimated from the appearance of the surface and the second (profile) can generally be controlled with broad limits by the choice of blast-cleaning procedures, notably of the type and grade of abrasive". Another very important point made by the specification is "A first quality finish is unlikely to be attained if the steel is deeply pitted or otherwise severely corroded".

The selection of abrasives is limited to those which have a maximum profile height of 4 roils.

Reference 81, an article written by R.A.N. McKelvie entitled "Steel Cleaning Standards - A Case for Their Reappraisal", is an excellent write-up on cleaning standards. Those readers interested in an in-depth discussion of cleaning standard should read this article.

2.4.2.2.3 Code of Practice for Protective Coatings of Iron and Steel Structures Against Corrosion BS 5493:1977 (7)

This British Standard "classifies recommended methods of protection against corrosion of iron and

steel structures exposed to environments commonly encountered." It is used to select methods and/or processes for the protection of steel structures to include procedures, surface preparations and generic types of coating material. The basic procedures areas follows:

1. Identify the exposure environment. - Table 1 is provided to assist in this operation.
2. Define service life requirements and select the appropriate paint system. "Table 3, Recommendations for protective coatings systems for specific environments" is organized into various types of environmental exposures. Specific generic paint types are recommended. The specifier makes the appropriate selection.
3. Define the system selected. Tables are also included to assist in, or reinforce, system selections.

Another table, Table 8, is a complete "Inspection Guide" to include "Potential Defects", "How determined", "Likely cause", and "Suggestions for action".

Overall, this standard is an extremely good reference document covering general painting practices and procedures.

2.4.2.3 JAPANESE STANDARDS

2.4.2.3.1 Standard for the Preparation of Steel Surfaces Prior to Painting (SPSS)(1975) (31)

This standard covers both initial (primary) surface preparation and touch-up (secondary) surface preparation requirements. The primary standard includes surfaces of hot-rolled steel in two different rust grades using both sandblasting and shotblasting techniques. Three different grades of quality are listed for each method. Each grade and each technique has a different alpha-numeric designation.

The secondary standard refers to surfaces of steel coated with various shop primers (wash primer: W, organic zinc primer: Z, inorganic zinc primer: 1) which were initially cleaned due to welding, burning, weathering, etc. The touch-up surface preparation methods defined within the standard are sandblasting, sweep sandblasting, disc sander and power wirebrush/disc sanding.

Each combination of techniques is defined by a different specification number. Initial steel conditions to include both coated and uncoated representations, and resultant surface preparation conditions, are each demonstrated by a separate color photograph. in all, 92 different color photographs are used to portray

surface conditions prior to and after initial and touchup surface preparation. This standard could be extremely valuable to shipbuilders.

2.4.2.4 SWEDISH STANDARDS

2.2.2.4.1 Pictorial Surface Preparation Standards for Painting Steel Surfaces (23)

This standard is jointly approved under the following specification numbers:

Steel Structures Painting Council — SSPC Visual/ Standard SSPC-Visl-67

Swedish Standards Institution — Swedish Standard S1S0559 00-1967

American Society for Testing & Materials — ASTM D 2200-67

Danish Standards Association — Danish Standard DS 2079

The standard consists of a series of color photographs which are demonstrative of four rust grades before and after various surface preparations. Four grades of abrasive blasting, one grade of hand tool cleaning and one grade of power tool cleaning are included. Only initial surface preparation techniques are covered. In all, the standard contains twenty-four color photographs.

The various grades of surface preparation are equated to the Steel Structures Painting Council Surface Preparation Specifications. However, the citing of an SSPC specification does not necessarily incorporate the use of the Swedish Standards. The use of this standard must be imposed by specific reference.

2.4.2.5 FRENCH STANDARDS

2.4.2.5.1 French Standard NFJ 18-100 requires that a shop primer last for six months, when applied at 0.75 mils, to meet the requirement for weldability and to limit the evolution of zinc oxide.

2.4.2.5.2 French Standard A35-511 and 512 concerns blast-cleaned and preprinted products for use other than marine construction.

2.5 Development of Shipbuilding Standards

Following the review of the standards and specifications discussed in the preceding paragraphs, an outline of the Practical Shipbuilding Standards for Surface Preparation and Coatings was developed. This outline was submitted to selected shipyards for review and comment. Following the receipt and resolution of all comments, the draft standard was developed. This standard was then

submitted to numerous shipyards for review and comment. These comments were then resolved and the final standard contained in Section 4 was developed.

2.6 Development of Paints and Coatings Product/Procedure Data Sheet

The objective of this task was to develop a standard form detailing material properties and application data for marine coatings. It was the intent that this material information sheet should contain provisions for information such as generic types of coating, special application procedures and equipment,

minimum surface preparation standards and procedures, environmental application limits (humidity and temperature) and spread rate.

Existing coating supplier's product data sheets were reviewed for adequacy and possible format. A preliminary format was adapted and submitted to many shipyards for review and comment. The comments were evaluated and differences resolved. The data sheet contained in Section 3 of this report is the result of that effort.

Instructions and sample forms are also included in Section 3.

SECTION 3

Paints and Coatings

product/Procedure Data Sheet

3.1 Instructions

When filling out the Product/Procedure Data Sheet remember that the information contained therin will be utilized by both technical and production personnel. Keep it simple and brief, BUT COMPLETE. The following instructions are organized by paragraph numbers contained within the data sheet. Also see the two examples contained within this section.

3.1.1 Paragraph 1— Generic Type and Description.

Use only known and industry accepted generic descriptions.

3.1.2 Paragraph II — Manufacturers Data.

This section is self explanatory, with the possible exception of sub-paragraph (f). This can be as complete or as brief as the concerned parties desire. For example, a separate attached list of compatible and incompatible topcoats or acceptable cargo exposures could be included.

3.1.3 Paragraph III— Properties.

This section is also self explanatory, with the possible exception of paragraph (a). If agreed upon by the concerned parties, a different method for determining volume solids (theoretical coverage) may be substituted. The form should be appropriately amended.

3.1.4 Paragraph IV — Surface Preparation

Minimum Requirements

1. Paragraphs (a) and (b) — Use an agreed upon standard; i.e., SSPC, Swedish, NACE, SNAME, etc.
2. Paragraph (c) — The profile listed must be given as a range. The method of measurement must be agreed upon by all parties concerned, or this paragraph can be left blank and the type and size of abrasive(s) allowed entered in paragraph (d), Special Instructions.

3.1.5 Paragraph V — Mixing Procedures.

This section is self explanatory, with the possible exceptions of paragraphs (c) and (f). Paragraph (c) should contain a generic solvent as opposed to a proprietary one. Paragraph (f) should, as a minimum, contain the mesh size of the straining material.

3.1.6 Paragraph VI — Application.

This section is one of the most important of the entire form. It must be filled out accurately and completely using all blocks in every paragraph. Sub-paragraphs (c), "For Immersion" is to be used for tank coatings, underwater bottoms and other specialty areas. Maximum recoat times should be expressed in hours, days, weeks or months. Equipment requirements should be brief.

SHIPBUILDERS AND MARINE**PAINTS AND COATINGS****PRODUCT / PROCEDURE DATA SHEET NO. _____**

Date: _____ Rev. _____

GENERIC TYPE AND DESCRIPTION:

Specification Number (If Applicable): _____

I. MANUFACTURERS DATA:

(a) MANUFACTURER:

(b) PRODUCT DESIGNATION:

(c) COLOR(S):

(d) USES:

(e) TECHNICAL SERVICE REPRESENTATIVE
(Include Telephone No.): _____

(f) NOT RECOMMENDED FOR:

II. PROPERTIES:

(a) % VOLUME SOLIDS (ASTM D2697):

(b) FLASH POINT (ASTM D93):
OR (ASTM D56): _____

(c) WEIGHT PER GALLON (FTMS141a 4184.1):

(d) SHELF LIFE:

(e) VISCOSITY (FTMS141a 4281):

(f) PACKAGING:

(g) NUMBER OF COMPONENTS:

(h) GLOSS (ASTM D523): _____

(i) STORAGE REQUIREMENTS: TEMP. MIN. _____ MAX. _____

SPECIAL SAFETY PRECAUTIONS:**IV. SURFACE PREPARATION MINIMUM REQUIREMENTS (USE SPECIFIC STANDARD NUMBERS):**

(a) INITIAL -

(b) TOUCH-UP -

(c) PROFILE(INCLUDE METHOD USED) - MIN. _____ MAX. _____

(d) SPECIAL INSTRUCTIONS -

(e) PRIMER REQUIREMENTS (IF APPLICABLE):

(OvER)

V. MIXING PROCEDURE:

(a) MIXING RATIO BY WEIGHT
BY VOLUME-

(b) INDUCTION TIME -

(c) RECOMMENDED SOLVENT - THINNING -
CONFINED AREAS -
NON-CONFINED AREAS -
CLEANUP -

(d) THINNING REQUIREMENTS (RATIO) -

(e) POT LIFE -
_____ Hr(s) @ _____ °F (_____ °c)
_____ Hr(s) @ _____ °F (_____ °c)
_____ Hr(s) @ _____ °F (_____ °c)

(f) SPECIAL INSTRUCTIONS -

VI. APPLICATION:

(a) ENVIRONMENTAL LIMITATIONS -

* TEMP. MIN. _____ MAX. _____

* % RELATIVE HUMIDITY MIN. _____ MAX. _____

(b) FILM THICKNESS (SSPC PA2-73T) - WET MIN. _____ WET MAX. _____
DRY MIN. _____ DRY MAX. _____

(C) DRY TIMES (ASTM D1650) - RECOAT MIN. - Hr(s) @ _____ °F (_____ °c) @ _____ % R.H.
MIN. - Hold @ _____ °F (_____ °c) @ _____ % R.H.
MIN. - Hr(s) @ _____ °F (_____ °c) @ _____ % R.H.

MAX. - Hr(s) @ _____ °F (_____ °c)

TO HANDLE MIN. - Hr(s) @ _____ °F (_____ °c) @ _____ % R.H.
MIN. - Hr(s) @ _____ °F (_____ °c) @ _____ % R.H.
MIN. - Hr(s) @ _____ °F (_____ °c) @ _____ % R.H.

FOR IMMERSION MIN. - Hr(s) @ _____ °F (_____ °c)
MIN. - Hr(s) @ _____ °F (_____ °c)
MIN. - Hr(s) @ _____ °F (_____ °c)

MAX. - Hr(s) @ _____ °F (_____ °c)

(d) EQUIPMENT REQUIREMENTS (INCLUDE PREFERRED, SUITABLE AND NOT SUITABLE REQUIREMENTS).

(e) SPECIAL INSTRUCTIONS -

* CAUTION SHOULD BE TAKEN THAT THESE CONDITIONS DO NOT COME WITHIN 5 °F OF DEW POINT.

SHIPBUILDERS AND MARINE**PAINTS AND COATINGS****PRODUCT / PROCEDURE DATA SHEET NO. 1-1-1****Date: Nov. 22.78 Rev. A****GENERIC TYPE AND DESCRIPTION:**Specification Number (If Applicable): Al kyl (Solvent Based) **Inorganic Zinc Silicate Primer****MANUFACTURERS DATA:**

(a) MANUFACTURER: R- Equal Paint Mfg Co.

(b) **PRODUCT DESIGNATION** 28-DG-1(c) **COLOR(S):** Gray(d) **USES:** preconstruction Primer(e) **TECHNICAL SERVICE REPRESENTATIVE**(Include Telephone No.): (100)-242-6000
N. I. T. ALL(f) **NOT RECOMMENDED FOR:**Immersion Service
See Technical Representative
for compatible topcoats**PROPERTIES:**(a) **%VOLUME SOLIDS(ASTM D2697):** 30(b) **FLASHPOINT(ASTM C193):80°****OR(ASTM D56):**(c) **WEIGHT PER GALLON (FTMS141a4184.1):** 12 lbs/gal(d) **SHELF LIFE:** 9 months(e) **VISCOSITY (FTMS141a4281):** T8 K.U.(f) **PACKAGING** Premeasured powder
packed in metal container. Pre-
measured liquid in polyurethane(g) **NUMBER OF COMPONENTS:** 2(h) **GLOSS (ASTM D 5231):** flat(i) **STORAGE REQUIREMENTS:** TEMP. MIN. N/A MAX. 140°F —**SPECIAL SAFETY PRECAUTIONS:**

See U. S. Department of Labor Material Safety Data Sheet

f. SURFACE Preparation MINIMUM REQUIREMENTS (USE SPECIFIC STANDARD NUMBERS):(a) **INITIAL- Commercial Blast,** SSPC-SP 6(1) **TOUCH-UP- Power Tool Clean;** SSPC-SP3(c) **PROFILE(INCLUDE METHOD USED)** Gardner Model 123 Profilometer **MIN. 1.0 mils MAX. 3.5 mils**(d) **SPECIAL INSTRUCTIONS:** Do not use power wire brush for power tool cleaning(e) **PRIMER REQUIREMENTS (IF APPLICABLE):** None**(over)**

72 Hr(s) @ 40 °F (4 °C)
48 Hr(s) @ 80 °F (27 °C)
24 Hr(s) @ 100 °F (38 °C)

II. APPLICATION:

* TEMP. MIN. _____

(b) FILM THICKNESS (SSPC PA2-73T) – WET MIN. 3.0 WET MAX. See Special Instructions
DRY MAX. "

(c) DRY TIMES (ASTM D1650) – RECOAT MIN. 24 Hr(s) @ 0 °F (-18) % R.H.

SHIPBUILDERS AND MARINE**PAINTS AND COATINGS****PRODUCT / PROCEDURE DATA SHEET NO. 2-1-1 | Date: Nov. 22, 78 | Rev. 1****GENERIC TYPE AND DESCRIPTION:** Epoxy Polyamide
Specification Number (If Applicable): MIL-P-23236**MANUFACTURERS DATA:****(a) MANUFACTURER:** R-Equal Paint Mfg. Co.**(b) PRODUCT DESIGNATION:** 40-DX-16**(c) COLOR(s):** Red, White, Blue**(d) USES:** Ballast Tanks**(e) TECHNICAL SERVICE REPRESENTATIVE**

N.I. - ALL

(f) NOT RECOMMENDED FOR:High temperature service
above 140°F**PROPERTIES:****(a) % VOLUME SOLIDS (ASTM D2697):** 50%**(b) FLASH POINT (ASTM D93):** 100°F
OR (ASTM D56):**(c) WEIGHT PER GALLON (FTMS141a 4184.1):** 12 lbs/gal**(d) SHELF LIFE:** 24 months**(e) VISCOSITY (FTMS141a 4281):** 120 K.U.**(f) PACKAGING:** 2 premeasured metal
container, one packaged inside
the other**(g) NUMBER OF COMPONENTS:** 2**(h) GLOSS (ASTM D523):**

Eggshell

(i) STORAGE REQUIREMENTS: TEMP. MIN. 0°F MAX. 140°F**SPECIAL SAFETY PRECAUTIONS:**

See U.S. Department of Labor Material Safety Data Sheet

SURFACE PREPARATION MINIMUM REQUIREMENTS (USE SPECIFIC STANDARD NUMBERS):**a) INITIAL - Near White Blast, SSPC-SP-10**For Recoat-First coat must be clean and dry. Mechanically etch if recoat time
(b) **TOUCH-UP** has expired.

Same as above. Limited power tool cleaning using disc grinders.

(c) PROFILE (INCLUDE METHOD USED): Gardner Model 123 Profilometer MIN. 1.5 MAX. 4.0(d) **SPECIAL INSTRUCTIONS -**

Do not use power wire brush

(e) PRIMER RETIREMENTS (INAPPLICABLE): Material is self priming. The first coat
is considered the prime coat.

MIXING PROCEDURE:

(a) **MIXING RATIO BY WEIGHT** - 6 lbs component A to 6 lbs of component B
BY VOLUME - 1 part component A to 1 part component B

(b) **INDUCTION TIME** - 30 minutes

(c) **RECOMMENDED SOLVENT-THINNING** -

CONFINED AREAS - #1 Solvent

NON-CONFINED AREAS - #2 Solvent

CLEANUP - 1 part xylene to 1 part **MIBK**

(d) **THINNING REQUIREMENTS (RATIO)** - 25% maximum

(e) **POT LIFE** -

<u>8</u>	Hr(s) @ <u>100</u> °F	<u>38</u> °C)
<u>12</u>	Hr(s) @ <u>80</u> °F	<u>27</u> °C)
<u>24</u>	Hr(s) @ <u>40</u> °F	<u>4</u> °C)

(f) **SPECIAL INSTRUCTIONS** -

Keep mixture under constant agitation during application. Strain mixture through #30 mesh strainer.

I. APPLICATION:

(a) **ENVIRONMENTAL LIMITATIONS** -

● TEMP. MIN. 50°F MAX. 120°F

* % RELATIVE HUMIDITY MIN. 50% MAX. 90%

(b) **FILMTHICKNESS (SSPCPA2-73T)** WET MIN. 8.0 WET MAX. 14.0
DRY MIN. 4.0 DRYMAX. 7.0

(c) DRY TIMES (ASTM D1650) - RECOAT MIN. 24 Hr(s) @ 80 °F (27 °C) @ 50 % R.H.
MIN. 48 Hr(s) @ 60 °F (16 °C) @ 50 % R.H.
MIN. 77 Hr(s) @ 50 °F (10 °C) @ 50 % R.H.

MAX. 6 mo Hr(s) @ °F (°C)

TO HANDLE MIN. 4.0 Hr(s) @ 50 °F (10 °C) @ 50 % R.H.
MIN. 2.0 Hr(s) @ 60 °F (16 °C) @ 50 % R.H.
MIN. 1.0 Hr(s) @ 80 °F (27 °C) @ 50 % R.H.

FOR IMMERSION MIN. 72 Hr(s) @ 80 °F (27 °C)
MIN. 144 Hr(s) @ 60 °F (16 °C)
MIN. 288 Hr(s) @ °F (°C)

MAX. N.A. Hr(s) @ °F (°C)

(d) **EQUIPMENT REQUIREMENTS (INCLUDE PREFERRED, SUITABLE AND NOT SUITABLE)**

Conventional Spray - Agitated pot, external mix spray gun with 0.070" tip combination
Airless Spray - 0.021" with 1200-1800 psi fluid pressure
Brush and Roller - Minor touch-up only

(e) **SPECIAL INSTRUCTIONS** - This material is to be applied in three coats using alternate color for each coat.

* CAUTION SHOULD BE TAKEN THAT THESE CONDITIONS DO NOT COME WITHIN 5 °F OF DEW POINT.

SECTION 4

Practical Shipbuilding

Surface Preparation

and

Coatings Standard

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Appendix 1 — Guide to Protective Coatings (Paint) Selection

Appendix 2 — Glossary of Terms

PROTECTIVE COATINGS (paints)

1.0 Scope

This document covers the standards governing the selection of protective coatings (paints) systems applied to ships' structures including appurtenances, attachments and components. Protective coating (paint) systems include surface preparation, application and paint material(s).

2.0 Use of the Standard

This document is an attempt to collect together, in one standard, all of the requirements necessary to successfully apply protective coatings to ships. Successful application is defined as "the protective coating performs as designed, i.e. provides corrosion protection, cargo protection, increased operating efficiency, aesthetics, etc., for a defined time period". This standard is not a specification in the sense of mandating requirements, but a guide which can be used to prepare contract specifications, good practices manuals, industry consensus specifications and/or quality assurance programs. It can be used in whole or in part. Each user (shipowner, naval architect, shipyard) may have specific requirements which exceed or fall below the recommended requirement of this document.

3.0 Applicable Documents — See Bibliography in Section 5.1

4.0 Use of Paints and Coatings Product/Procedure Data Sheet(s) (P/PDS).

4.1 Purpose of P/PDS

The P/PDS is a two-page data sheet which contains both technical and application requirements of a specific protective coating. It can be used by engineers to select candidate coatings which meet contract requirements, by production management to evaluate potential production problems, by quality control personnel to check attributes and by craft supervision in the actual coatings application.

4.2 Procedure for Using P/PDS

During the negotiation stage between shipyard and coating supplier(s), and prior to protective coatings material selection, each material supplier shall submit "Shipbuilding and Marine Paints and Coatings Product/Procedure Data Sheets" to the shipbuilder/construction firm for each protective coating proposed for use on a given contract. The shipbuilder/construction firm will review the submitted

procedures to determine compatibility with the governing contract specification and the manufacturing facility. After material selection, the finalized, approved Product/Procedure Data Sheet(s) become the basic document governing the surface preparation and application of each specific protective coating.

5.0 Storage

5.1 All protective coatings shall be stored in such a manner as to preclude eradication of labels/markings and subsequent loss of identification and/or batch number. Specific storage requirements and shelf life are covered in Section III (i) of Product/procedure Data Sheet.

5.2 Procedures shall be established to ensure that the oldest stock material is used prior to newer/fresher material; "first manufactured-first used". Containers should be marked with batch number and date of manufacture expressed as easy-to-read month, date and year. This requirement is in addition to any date code that maybe used.

5.3 Labels and markings shall be firmly attached to containers and designed to withstand short periods of outside storage without loss of identification.

6.0 Mixing and Thinning

6.1 All materials shall be mixed and/or thinned (reduced) in strict accordance with Section V of the pertinent Product/Procedure Data Sheet.

6.2 [n addition, the following minimum procedures shall be followed.

6.2.1 Where a skin has formed in the container, the skin shall be cut loose from the sides of the container, removed, and discarded. If such skins are thick enough to have a practical effect on the composition and quality of the paint, the paint shall not be used. If a question as to acceptability persists, the coatings supplier shall be consulted.

6.2.2 All ingredients in any container of paint shall be thoroughly mixed before use.

6.2.3 protective coatings mixed in the original container shall not be transferred until all settled pigment is incorporated into the vehicle. This does not imply that part of the

vehicle cannot be poured off temporarily to simplify the mixing.

6.2.4 Mixing shall be by mechanical methods, except that hand mixing shall be permitted for containers up to one (1) gallon in size.

6.2.5 Protective coatings shall NOT be mixed or kept in suspension by means of an air stream bubbling under the paint surface.

6.2.6 All protective coatings shall be strained after mixing. Care shall be taken with such coatings as inorganic zinc and aluminum to insure that the sieve size of the strainer is not so small as to reduce the amount of pigment in the strained mixture.

6.2.7 Dry pigments which are separately packaged shall be mixed into protective coatings in such a manner that they are uniformly blended and all particles of the dry powder are wetted by the vehicle.

6.2.8 Protective coatings which do not have a limited pot life, or do not deteriorate on standing, may be mixed at any time before using. Protective coatings shall not remain in spray pots, painters' buckets, etc., overnight, but like material shall be gathered into a container and remixed before use.

6.2.9 Catalysts, curing agents or hardeners which are separately packaged shall be added to the base paint only after the latter has been thoroughly mixed. The proper volume of the curing agent shall then be slowly poured into the required volume of base with constant agitation. If required, allow for the induction time recommended by the coating supplier as listed on the Product/Procedure Data Sheet.

6.2.10 Do NOT pour off the liquid which has separated from the pigment and then add the curing agent to the settled pigment to aid mixing. The mixture shall be used within the time interval specified on the Product/Procedure Data Sheet.

6.2.11 Zinc rich, and other types of material which have a tendency to settle rapidly, shall be continually mixed during application. See Product/Procedure Data Sheet for special instructions.

7.0 SURFACE PREPARATION

7.1 General

The primary consideration of any method, procedure, or standard concerning surface preparation is that the surface is thoroughly cleaned of any material which will be conducive to premature failure of the protective coating and a suitable "tooth" is provided for proper paint adhesions. The surface preparation method/standard shall allow for the removal of sufficient deleterious matter so that the type of primer (or coating) specified can wet the surface enough to develop adequate adhesion and at the same time eliminate contaminants which lead to premature coatings failure. The necessary kind and degree of surface preparation are dependent upon the substrate material and its condition, the nature of the prime coat, the topcoats to be applied, and the service conditions and performance requirements of the coating system. It is, therefore, appropriate that the surface preparation requirements shall be specified in detail.

7.2 STANDARDS

7.2.1 Written Standards

Where the following processes are specified, the noted standard shall apply:

Process	British Standard	Swedish Standard	SSPC	NACE
Solvent Cleaning			SSPC-SP 1-63	
Hand Tool Cleaning			SSPC-SP 2-63	
Power Tool Cleaning			SSPC-SP 3-63	
White Metal Blast Cleaning	First Quality	SA3	SSPC-SP 5-63	No. 1
Commercial Blast Cleaning	Third Quality	SA2	SSPC-SP 6-63	No. 3
Brush-Off Blast Cleaning			SSPC-SP 7-63	No. 4
Near-White Blast Cleaning	Second Quality	SA25	SSPC-SP 10-63T	No. 2
Pickling			SSPC-SP 8-63T	

7.2.2 Visual Standards

Where specified on the Product/Procedure Data Sheet, one or more of the following standards should apply:

I TITLE	STANDARD
pictorial Surface Preparation Standards for Painting Steel Structural (Known as the Swedish Standards).	SSPC-Vis-I-67T
Visual Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive.	NACE Standard TM-01-70
Visual Standard for Surfaces of New Steel Centrifugally Blast Cleaned with Steel Grit.	NACE Standard TM-01-75
Visual Standard for Surfaces of New Steel Steel Centrifugally Blast Cleaned with Steel Shot.	NACE Standard TM-01-75
Standard for the Preparation of Steel Surface prior to Painting (Japanese Standard).	JSRA-1975
Abrasive Blasting Guide for Aged or Coated Steel Surfaces	SNAME T & R Bulletin No. 4-9

As an alternate to one of the standards listed above, and if agreed upon by the concerned parties, a standard blast coupon demonstrating the abrasive used and the resulting appearance of the surface shall be created. Minimum size should be 6" x 6". This can be accomplished during the pre-construction conference, held after protective coating selection but prior to actual construction start. A representative steel panel(s) shall be abrasive blasted to a condition agreed upon by the parties present (Shipyard, Owner, Supplier) as being representative of the specified blast finish(es). This panel(s) will then be protected from rusting either by encapsulation in a clean plastic resin or protected by other means such as rust preventive paper.

7.3 Ungalvanized Structural Steel

7.3.I Steel shall be sound and free from such segregation, cracks, laminations or surface flaws that may preclude successful protective coating performance. Surface lamination, shelling, cracks, crevices, inclusions and surface flaws shall be removed prior to surface preparation and coating. Burrs shall be removed and sharp edges ground to a 1/16" radius prior to coatings application. For extremely severe service areas such as chemical tanks, sharp edges shall be ground to a 1/8" radius.

7.3.2 Initially, all ungalvanized structural steel shall be abrasive blast cleaned to a surface preparation standard specified in the respective Product/Procedure Data Sheet for the particular protective coating (paint) which is specified to be applied over the substrate in question. As a minimum, severe service areas such as exterior exposed to weather, tanks and other defined areas, shall be abrasive blasted to Near White Blast Cleaning (SSPC-SP 10-63 T). All other structural steel shall be abrasive blasted to a minimum of Commercial Blast Cleaning (SSPC-SP6-63) or pickled (SSPC-SP8-63).

7.3.3 Procedures, equipment requirements, and surface preparation standards for touch-up shall be defined in Section IV (b) of the Product/Procedure Data Sheet (s). Surface preparation and coating shall be so programmed that detrimental amounts of dust, or other contaminants, do not fall on cleanly prepared surfaces or on wet, newly painted surfaces. Surfaces not intended to be coated shall be suitably protected from the effects of surface preparation and coating operations.

7.3.4 For interiors of lube oil tanks including stiffeners, pickling or Commercial Blast

Cleaning prior to erection is acceptable provided all blast by-products are removed.

7.3.5 The term "exterior exposed to weather" as used in paragraph 7.3.2 above includes: a) deck machinery, masks, davits, exteriors of motor housings, and similar installations; b) interiors of foundations, pedestals, and equipment housings which have openings to the atmosphere; c) underside of weather decks hatch covers; d) interiors of weather deck ventilation duct for a distance of about 2.0 to 2.5 m (6 to 8feet) from the openings; e) and areas between the backs of control boxes and superstructure if not seal welded.

7.4 Galvanized Steel and Miscellaneous Non-Ferrous Metals Excluding Aluminum

Stainless steel, galvanized steel and other miscellaneous metals specified to be coated shall be cleaned to remove dirt, grease, corrosion products and other surface contaminants prior to application of coatings. Where abrasive blasting or mechanical tools are used, care shall be taken to only slightly roughen the surface to provide a good paint bond.

7.5 Plastic and Fiberglass

Surfaces requiring painting shall be lightly roughened. All extraneous matter shall be removed by wiping with a solvent and hand sanding, or by other means, to produce a good coating paint bond. Wash Primer (MIL P-15328 or acceptable proprietary

material) shall be applied prior to application of cosmetic coats.

7.6 Aluminum and Aluminum Alloys

Aluminum and/or aluminum alloys shall be cleaned by one or more of the following processes:

- A. Solvent Cleaning
- B. Brush-Off Blast Cleaning (do not use stainless steel, iron or steel grit as the blast media).
- C. Chemical Clean (MIL-M-10578, Type 1, "Alumiprep", or other approved commercial process).

7.7 Interior Equipment and Components

Interior equipment and components supplied as completed end items shall be cleaned and painted in accordance with approved best commercial practice. Information concerning the exact procedure and protective coating system used shall be submitted by the equipment manufacturer to the shipyard/construction firm. If the shipyard prefers, and the equipment manufacturer agrees, equipment may be supplied prime-coated with finish coats to be applied by the shipyard after installation.

7.8 Chemical Pretreatments

7.8.1 If imposed as a requirement of the contract specification and/or Product/Procedure Data Sheet, the following process(es) shall be specified:

Material	Specification	Title
Ferrous and/or Zinc Coated Steel	MI L-C-490A	Military Specification for Cleaning and Preparation of Ferrous and Zinc Coated Surfaces for Organic Protective Coatings.
Aluminum and Aluminum Alloys	MIL-C-5541B "Alodine" or other approved commercial process.	Chemical Conversion Coatings on Aluminum and Aluminum Alloys.
Magnesium Alloys	MI L-M-3171	Magnesium Alloy, Processes for Pretreatment and Prevention of Corrosion On.

7.8.2 MI L-P-15328, Primer, Wash, Pretreatment can be substituted for MIL-C-490A on ferrous or zinc coated surfaces and for MIL-C-5541B on Aluminum and Aluminum Alloy Surfaces.

7.8.3 Proven and approved commercial practices can be substituted for any of the above processes when approved in writing by the owner and shipyard/construction firm.

7.9 Attention to Detail

Apart from surface preparation of the main bulk of the structural steel, attention shall also be paid to such details as:

- 7.9.1 Burrs caused by removal of temporary lugs, etc. should be ground flat.
- 7.9.2 Welds shall be dressed and weld spatter removed by grinding.
- 7.9.3 Nuts and bolts shall be properly treated.
- 7.9.4 Fasteners, such as pipe-hangers, shall be treated before being fixed to the main structure.

7.10 Abrasives Used for Abrasive Blast Cleaning Operations

- 7.10.1 The surface roughness achieved for each of the degrees of cleanliness depends mainly upon the type of steel, its condition before blast-cleaning, the type and size of abrasives used and the force at which the abrasive is propelled.
- 7.10.2 The sizes and types of abrasives used must be selected to produce a degree of roughness (profile) which falls within the minimum/maximum range as specified on the Product/Procedure Data Sheet.
- 7.10.3 The method of measuring roughness (profile) shall be agreed upon by parties involved; i.e., Protective Coatings supplier, Owner, and Shipyard/Construction Firm.
- 7.10.4 The use of coarse blast media is unsuitable for thin materials or where a fine surface finish is required. In general, it is the surface cleanliness and not the roughness which enhances adhesion values of protective coatings. The one exception to this point concerns high build coatings in which the internal cohesive strength of the material exceeds its adhesive strength to the substrate. The normal recommended profile (anchor pattern) varies with the range of 1 to 4 mils (25 -100 pm).

8.0 APPLICATION

8.1 General

Protective Coatings may be applied by brushing, air spraying, airless spraying, dipping or hot spraying or a combination of these methods. Daubers or sheepskins may be used when no other method is practicable for proper application in places of difficult access. Roller coat application may be used on flat or slightly curved surfaces, over blast cleaned or pickled surfaces, or over primed or striped portions of surfaces. Unless specifically authorized, or unless the

coating over such areas is subsequently brushed out, roller coat application shall NOT be used in application of primer over hand tool cleaned, power tool cleaned, or flame cleaned irregular surfaces such as rivets, bolts, crevices, corners or edges. Flow coating shall be used only when specifically authorized. Special provisions for specific methods of application are given in each Product/Procedure Data Sheet. Where a conflict exists between the general standard and the Product/Procedure Data Sheet, the latter shall prevail.

8.2 Equipment and Tools

Protective coatings surface preparation and application equipment shall be kept clean and in good mechanical working order. Equipment used shall be suitable for the intended purpose.

8.3 Compressed Air Quality;

Air supply lines for spray equipment, blasting equipment or for air blast removal of dust from surfaces, shall be provided with adequate air driers to remove oil and condensed water from the air. No visible deposit shall appear when a jet of air is allowed to impinge on a clean metal surface for 15 seconds. Pneumatic hand tools can also be a source of oil contamination. The tools utilized for protective coatings surface preparation shall not be equipped with oilers.

8.4 Manual Spray Application

After proper mixing of protective coatings, and adjustment of application equipment to achieve an acceptable spray pattern, apply coatings in even, parallel passes, overlapping each pass fifty (50%) percent to insure thorough coverage and that a wet layer of paint is deposited on the surface. Hold the spray gun at least six inches, but no more than ten inches from the surface to be coated when using air atomization equipment, and a minimum of eight inches when using airless equipment. Move the gun parallel to the surface at all times. Do not swing it in an arc or shoot at an angle. Check wet film thickness intermittently during application to ensure proper film build. If cross hatching is specified, apply the first pass in the prescribed horizontal manner, as outlined above; wait approximately three minutes and then apply a second coat by a vertical movement of the gun, perpendicular to the first horizontal application.

8.5 Automatic Spray Application

When using automatic spray application equipment, ensure that the protective coating is applied in even, wet coats of adequate thickness to yield the MDFT required. Each square of surface area must have the same amount of material applied.

8.6 Brush Application

The brushing shall be done so that a smooth coat as nearly uniform in thickness as possible, is obtained. This usually may best be accomplished by applying the protective coating in short strokes, depositing uniform amounts of coating in each stroke, brushing the coating into all surface irregularities, and finally smoothing or leveling the coating film with longer strokes at about right angles to the direction of the first strokes, allowing only enough of the tip of the bristles to drag in the coating film to smooth the film without leaving deep or detrimental brush marks.

8.7 Environmental Considerations

8.7.1 Temperature

The minimum and maximum temperatures

as listed in Section VI (a) of the Product/Procedure Data Sheet are applicable to both air and substrate temperatures. These requirements shall be strictly adhered to.

8.7.2 Moisture, Humidity and Dew Point

Protective Coatings shall not be applied in rain, snow, fog or mist or when the steel surface temperature is less than 5°F above the dew point of the surrounding air resulting in condensation of moisture. Table I contains dew point information. Special humidity limits for each material are listed in Section VI (a) of the Product/Procedure Data Sheet. These limits shall be strictly adhered to.

TABLE I

Dew Point Calculation Chart (Fahrenheit)

AMBIENT AIR TEMPERATURE°

% RELATIVE HUMIDITY	20	30	40	50	60	70	80	90	100	110	120
90	18	28	37	47	57	67	77	87	97	107	117
85	17	26	36	45	55	65	75	84	95	104	113
80	16	25	34	44	54	63	73	82	93	102	110
75	15	24	33	42	52	62	71	80	91	100	108
70	13	22	31	40	50	60	68	78	88	96	105
65	12	20	29	38	47	56	66	76	85	93	103
60	11	19	27	36	45	55	64	73	83	92	101
55	9	17	25	34	43	53	61	70	80	89	98
50	6	15	23	31	40	50	59	67	77	86	94
45	4	13	21	29	3 7	4 5	5 6	6 4	7 3	82	91
40	1	11	18	26	35	43	52	61	69	78	87
35	2	8	16	23	31	40	48	57	65	74	83
30	6	4	13	20	28	36	44	52	61	69	77

Dew Point: Temperature at which moisture will condense on surface. No coatings should be applied unless surface temperature is a minimum of 5°F above this point. Temperature must be maintained during curing.

Example: If air temperature is 70°F and relative humidity is 65%, the dew point is 57°F. No coating should be applied unless surface temperature is 62°F minimum.

8.7.3 Ventilation

Not only is proper ventilation one of the most important aspects of coatings application and proper protective coating cure, it is also extremely important from a safety aspect. Table II gives the recommended air flows to maintain solvent vapor concentra-

tions below ten (10%) percent of the lower explosive limit. Ventilation equipment must be left in place and in operation during the entire paint cure time period. The OSHA requirements for lower toxic limits must also be complied with (see specific OSHA requirements).

Tank Volume			Shell Area, Sq. Ft.	Appx. Air Change Rate, rein/tank vol.	Air Mover Capacity, cfm (free air)
Bbl	Gal	Cu. Ft.			
119	5,000	670	280	0.6	1,000
238	10,000	1,340	450	1.0	1,200
356	15,000	2,000	680	1.3	1,500
500	21,000	2,800	850	1.4	2,000
1,000	42,000	5,600	1,130	2.0	2,500
1,500	63,000	8,400	1,415	3.0	3,000
2,000	84,000	11,200	1,860	3.0	4,000
2,500		14,000	2,360	3.0	5,000
5,000	—	28,000	3,770	4.5	6,000
10,000	—	56,000	5,340	5.5	10,000
15,000		84,000	7,240	5.5	15,000
20,000		112,000	7,540	5.5	20,000
30,000		168,000	10,100	5.5	30,000

TABLE II — Air flow recommended to maintain solvent vapor concentrations below 10% of the lower explosive limit.

8.8 Cover/Protection

Coated surfaces shall remain under cover or be protected until "dry-to-handle" time has expired. See Product/Procedure Data Sheet Section Vi (c).

8.9 Damage/Repair

8.9.1 In mechanically damaged areas, repair and replace coats of protective coatings (paint) as required according to procedural requirements contained in the respective Product/Procedure Data Sheets for each protective coating. Care shall be exercised to ensure that the coating around the damaged area is "feathered" back to sound adjacent paint prior to subsequent paint application. Care shall be taken to rebuild the complete touch-up protective coating (paint) system to the original specified film thickness.

8.9.2 If insufficient minimum dry film thickness is discovered, apply additional coat(s) of material as required to achieve specified film thickness (NOTE: Minimum and maximum recoat times on Product Sheet). prior coats of paint must be clean, dry and free of grease and oil. Some aged coatings may require mechanical etching.

8.9.3 If the application of other than the specified product is discovered, the owners representative shall be notified for required disposition.

8.10 Stripping/Sniping

In ballast tanks, product tanks, and other identified critical service areas, sharp exposed edges, bolts, rivets and other similar features shall be given an extra coat of paint. This coat shall be applied by brush before the normal intermediate or finish coat is applied. This requirement does not apply prior to application of prime coats.

8.11 Film Thickness

8.11.1 During the application of each coat of protective coating the wet film thickness shall be checked often enough by the applicator using a wet film thickness gauge to insure adequate film build.

8.11.2 The dry film thickness shall be checked after complete film hardening utilizing either a permanent magnet (steel substrates only) or eddy current instrument. Both minimum and maximum (if specified) film thickness as listed on Product/Procedure Data Sheet Section VI (b) shall be met.

8.11.3 When film thickness is determined with magnetic gauges, the gauges shall be calibrated and the measurements made in accordance with the latest issue of Steel Structures Painting Council Method SSPC-PA-2-73T. Eddy current instruments shall be calibrated in accordance with ASTM Method D1400.

8.12 Overcoating

- 8.12.1 When coatings are being applied for corrosion protection; i.e. underwater bottom, ballast tanks, product tanks, boottop, freeboard and other owner defined areas, alternate coats will be of different colors, or shades, to aid in detecting lack of complete coverage.
- 8.12.2 When overcoating inorganic zinc paints which have not aged (less than 60 days), first apply a mist coat of the intermediate coat to seal the porous inorganic zinc and therefore eliminate blisters and pin holes.
- 8.12.3 Minimum and maximum recoat times shall be in accordance with the requirements specified in section VI (c) of the Product/Procedure Data Sheet. In all cases, the prior coat shall be clean and free of condensation prior to overcoating.
- 8.12.4 Exterior applications of inorganic zinc silicate to decks and other areas subject to oil and grease contamination, shall be overcoated before oil and grease contamination may occur. A check for contamination shall be made prior to application. The inorganic zinc shall be fully cured prior to application of succeeding coat. In all cases concerning the overcoating of inorganic zincs, the manufacturers instructions, as expressed in the Product/Procedure Data Sheet, shall be followed.

9.0 COLOR

9.1 Pipe color codes shall be in accordance with ASA A 131-1956, "Scheme for the Identification of Piping Systems".

9.2 American National Standards Institute Safety colors, ANZI Z53.1-1971, shall be used to distinguish hatch openings, machinery, mooring parts and fittings which present a hazard.

9.3 Compressed gas cylinders shall be color banded in accordance with MIL STD-101B.

9.4 If specified in the contract specification, steel shall be identified in accordance with _____ (This standard is presently being developed).

9.5 Finish Colors shall be to the Owner's choice.

10.0 SPECIAL REQUIREMENTS

10.1 Keel

The shell in the way of keel and bilge blocks shall be coated and fully cured before laying on the keel blocks and shall be protected from components in the

wood blocking by means of aluminum foil, at least 50 micrometers (0.002 inches) thick, or an alternate protection of oiled paper or vinyl sheets, greased in contact with vinyl paint.

10.2 Compatibility

- 10.2.1 All paints within a given coating system shall be from the same supplier.
- 10.2.2 Each coating system shall be compatible within itself, with other systems at the interface and substrates. Care shall be taken in selecting coating systems to assure that cure byproducts from one coating system do not yellow or otherwise effect another coating system.
- 10.2.3 All specified coatings shall be compatible with the shipbuilders application and construction methodology to include environmental constraints.
- 10.2.4 Coatings shall be compatible with the cathodic protection systems. At such time as the cathodic protection system is selected, the specific operating parameters of the system; i.e. voltage, current density, shield material, etc. shall be submitted to the paint manufacturer for review. The paint manufacturer shall then submit a letter to the shipbuilder certifying the compatibility of the supplied protective coating system with the cathodic protection system. Anodes shall be protected during surface preparation and coatings application.

10.3 Walking and Working Surfaces

Walking and working areas, including but not limited to staircases, gangways, and platforms shall be coated with "non-slip" type coatings, or shall be finished by other means which will result in a substantially higher coefficient of friction for these surfaces as compared to adjacent surfaces not so treated.

10.4 Components

- 10.4.1 Contract specifications shall specifically identify all areas that are not to be coated. Where not otherwise stated, all structural and nonstructural parts, and spaces, doors, fittings, vendor supplied items, etc., which are normally coated shall, after proper surface preparation, be coated to conform to the surrounding or to comparable parts or spaces.
- 10.4.2 Except for specialty items such as steam line components, ungalvanized, ferrous pipe, pipe hangers, wireway hangers, foundations

and miscellaneous structural attachments shall be cleaned, primed and coated with the same generic paint system as the surrounding structure.

10.4.3 Abrasive blasting of deck machinery and external surfaces of motor housings specified to receive inorganic zinc silicate, shall be accomplished by the equipment manufacturer. The intermediate coat should also be applied by the equipment supplier.

10.5 Calculating Coverages

When calculating material coverage and/or consumption factors the volume solids (non-volatile content by volume) of each protective coating shall be calculated according to ASTM Method D 2697-68, or as agreed upon by the shipbuilder.

10.6 Timing of Coating Operations

If possible, finish coating should be delayed until the final stages of ship construction (after structural completion) at which time the possibility of damage from other crafts is minimal. Tanks and voids should be finish painted after tank completion and tank test. Areas which become inaccessible during the construction cycle must be coated or protected prior to closure.

10.7 Antifouling Applications

Antifouling coatings shall be undocked within the time frame between application and immersion as listed in paragraph VI (c) of Product/Procedure Data Sheet,

10.8 Optimum Number of Coats

Each generic type of coating system has an optimum number of coats of material; however, unless otherwise specified, three (3) should be applied in severe service areas such as ballast tanks, underwater bottom, etc. Inorganic zinc is one notable exception to this rule. It is designed as a one coat system.

10.9 Faying Surfaces

10.9.1 Steel

Interior faying surfaces of steel to steel, except when formed by a continuous weld, shall receive two coats of primer on each faying surface prior to closure. Optional primers are pretreatment primer (limited to one coat), red lead primer, zinc chromate primer, preconstruction primer, or inorganic zinc. Riveted or bolted faying surfaces exposed to weather or dampness shall be further protected by applying Joint Sealing Material, MIL-J-2829 to 2.5 mm (0.050 inch)

thickness, or approved commercial equivalent.

10.9.2 Aluminum

Interior surfaces which are specified to be coated shall be given one coat of pretreatment primer or preconstruction primer. In wet spaces, another coat of primer shall be applied over the pretreatment. Optional primers are zinc chromate or preconstruction primer. Red lead and inorganic zinc primers shall not be used on aluminum. Faying surfaces of aluminum to aluminum exposed to weather shall be coated with one coat of zinc chromate or preconstruction primer. In addition to the above requirements, faying surfaces of aluminum requiring stop-waters or oil stops shall be sealed with caulking compound, MI L-C-18969 or approved commercial equivalent.

10.9.3 Dissimilar Metals

10.9.3.1 Dissimilar metals in intimate contact or connected by a conductive path, such as water, shall be allowed only when the functional design or other important considerations render this unavoidable.

10.9.3.2 Faying surfaces of dissimilar metals shall, if possible, be insulated from one another. Where a complete dielectric separation cannot be implemented, the electrolyte path should be increased. Every effort shall be made to avoid the unfavorable area effect of small anode and large cathode. The exact design of these joints are beyond the scope of this specification. Numerous books on corrosion design are available. If only one member is coated, it shall be the cathode.

10.9.4 Non-Continuous Welds

When exposed to weather, or other severe service areas, non-continuous welds shall be caulked prior to the application of the protective coatings.

10.10 Galvanizing

10.10.1 The following specifications apply as noted concerning hot-dip galvanizing:

Item	Specification
welded and Seamless Steel Pipe	ASTM A 53-72a
Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, pressed & Forged Steel Shapes, Plates, Bars & Strip	ASTM A123-73
Zinc Coatings (Hot-Dip) on Iron and Steel Hardware	ASTM A153-73

10.10.2 In addition to the above listed specific requirements, the following two (2) general requirements shall also apply.

- A. ASTM A385-62, "Providing High Quality Zinc Coatings (Hot-Dip) on Assembled Products".
- B. ASTM A386-73 "Zinc Coating (Hot-Dip) on Assembled Steel Products".

10.10.3 Damaged galvanized surfaces shall be cleaned and sprayed with 0.67 kg of zinc metal per square meter (2 oz. per sq. foot), or 85 micrometers (3.4 roils) thick, or be repaired using "Cold Galvanized Repair Paint", MI L-P-21035, "Galvacon", "Gal vex" or other approved commercial material.

10.10.4 Where possible, ferrous piping or other small steel fabrications required to be galvanized shall preferably be galvanized after fabrication.

10.11 Insulation

Two coats of primer shall be applied in way of insulation.

10.12 Deck Coverings

Deck coverings shall be in accordance with the deck covering specifications and will not be addressed in this specification.

10.13 Items not to be Coated

The following items shall not be coated:

- A. Bell pulls, sheaves, annunciator chains and other mechanical communication devices.
- B. Composition heads and outer surfaces of condensers.
- c. Exposed parts of machinery.
- D. Glands, stems, yokes, toggle gear and all machined external parts of valves.
- E. Heat exchange surfaces of heating or cooling equipment.
- F. Anodes
- G. joint faces of gaskets and packing surfaces.
- H. Lubricating gear such as oil holes, oil or grease cups, lubricators, and surfaces of reciprocating engines and pumps.

J. Nameplates.

K. Rubber resilient elements of isolation mounts.

L. Sliding feet.

M. Springs

N. Threaded parts

O. Turbine casing joints

10.14 Hot Surfaces

TT-P-28d or commercial equivalent Heat Resistant Paint shall be applied to surfaces which are designed for elevated temperature service up to 650°C (1200°F).

10.15 Inaccessible Voids

Inaccessible voids shall be coated with Rust Preventative Compound (MIL-C-16173D) (Grade 1), or commercial equivalent, by filling and draining; by the application of foamed-in-place polyurethane (two pounds per cubic foot density) or approved commercial process.

11.0 PROTECTWE COATINGS SYSTEMS SELECTION

11.1 It is not the intent of this specification to dictate exact generic types of protective coating(s), protective coating system(s), number of coats of paint within a given system nor film thicknesses; however, the following requirements are mandated:

- A. paragraph 4.7.5 as concerns the minimum number of coats of paint within severe service areas.
- B. Ballast tank coatings selected must be listed on QPL-23236 of MIL-P-23236, "Paint Coating Systems, Steel Ship Tanks, Fuel and Salt Water Ballast."
- c. Paints defined as Inorganic Zinc must meet the requirements of SSPC-Paint 20X, Type I and SSPC-PS-12.01 .
- D. Each coating system selected for severe service areas; i.e., underwater bottom, boottop, freeboard, superstructure, exterior decks, ballast and product tanks, shall have a proven history of satisfactory seagoing ship service for a minimum of two (2) years in the applicable area. Extensive laboratory screening to include a test patch on a ship in service applied to the applicable area, plus an extended guarantee, may be substituted if

agreeable to all parties (shipyard, owner and paint suppliers).

11.2 The format shown in Table III shall be utilized for detailing the protective coating system(s) selected.

11.3 The listing of generic types, rather than of brand names, is the preferred method of specifying coatings. The exact number of coats of paint, the film

thicknesses specified and the specific coating selected shall not be listed until final protective coatings (paint) selection after contract award.

11.4 Appendix 1, "Guide to Protective Coatings (Paint) Selection," contains some traits and advantages of generic coatings which maybe helpful in making protective coating selections.

Space, Part or Component	Initial Surface Preparation	Generic Description of Selected Coatings System, No. of Coats, Specification, Color	*MDF Thickness	Notes
Boottop	SSPC-SP1063T	1. Polyamide Epoxy, Red 2. Polyamide Epoxy, Gray 3. Polyamide Epoxy, White 4. Vinyl Antifouling, Copper, Red 5. Vinyl Antifouling, Copper, Red	2.0 4.0 2.0 1.5	1.

TABLE III

NOTES: 1. Reduce 10% with strong solvent and apply over last coat of epoxy within 48 hours.
*Minimum Dry Film Thickness

12.0 SAFETY AND POLLUTION CONTROL

The requirements listed in this section are general requirements and are by no means all inclusive as concerns safety. The Federal Occupational Safety and Health Act of 1970 (OSHA) as amended should be consulted for more detailed requirements.

12.1 All protective coatings (paints) used which make pesticidal claims shall be registered with the U.S. Environmental Protection Agency.

12.2 Local jurisdiction solvent regulations shall be complied with by the use, when required, of complying substitute solvents, demonstrated as being suitable in coating performance and shelf life stability.

12.3 U.S. Department of Labor, Wage and Labor Standards Administration, Bureau of Labor Standards, Material Safety Data Sheets shall be submitted by the material supplier on all materials, (paints, solvents, abrasives, etc.) proposed for use on a given contract. These Material Safety Data Sheets shall be submitted during the procurement cycle in order that a review can be effected prior to final material selection.

12.4 Materials used for application in enclosed spaces shall have a minimum flash point of 29.4°C (85°F).

12.5 Safety solvents shall be used for cleaning. Flammable safety solvents, suitable for use, must have a minimum flash point of 37.8°C (100°F). Gasoline, and benzene (benzol) shall not be used. The preferred safety solvent is 1,1,1- trichloroethane which has no flash point and a high TLV.

13.0 QUALITY ASSURANCE

13.1 General

13.1.1 This standard provides a common basis for the quality assurance of protective coatings applied to ships.

13.1.2 Quality assurance, as defined in this standard, comprises all those planned and systematic actions necessary to provide specified documentation and adequate confidence that protective coatings work for ships will perform satisfactorily in service.

13.1.3 Quality assurance includes quality control, which comprises those quality assurance actions related to the physical characteristics of the entire protective coatings work as a means of providing compliance with the specified requirements of the contract specification.

13.2 Quality Assurance Program

Each shipyard/construction firm shall have a written quality assurance program which assures control of the following:

- A. Quality of the Protective Coatings Material
- B. Surface Preparation
- C. The Conditions and Methods of Application
- D. Inspection Procedures and Acceptance Criteria.

13.3 Quality Control

13.3.1 Quality of the Protective Coatings Material

Test	Standard
Weight Per Gallon	*FTMS 141a 4184.1
Viscosity	
Krebs-Stromer	*FTMS 141a 4281 or **ASTM D 526-55
Ford	*FTMS 141a 42820 **ASTM D 1200-70
Fineness of Grind	*FTMS 141a 4411.1 or **ASTM D 1210-64
Drying Times	*FTMS 141a 4061.1 or **ASTM D 1650-69
Nonvolatile Content	
By Weight	**ASTM D 2832-69
By Volume	**ASTM D 2697-68
Condition in Container	*FTMS 141a 3011.1

*Federal Test Method Standard Number

**Part 27, Annual Book of ASTM Standards, American Society for Testing and Materials

13.3.1.2 From this one (1) gallon sample a one (1) quart retain sample shall be stored for future reference. This retain will be kept on hand until the shelf life expires at which time a new retain shall be requested from the supplier. Subsequent retains shall be checked against the original data.

13.3.1.3 The data obtained from the retain

sample shall be recorded and utilized as baseline data for comparison against each batch of material received for use under the contract.

13.3.1.4 Each batch of fifty (50) gallons or more of protective coatings received under the contract shall, as a minimum, be tested according to the following procedures.

Test	Standard
Weight Per Gallon	*FTMS 141a 4184.1
Viscosity	
Krebs-Stromer	*FTMS 141a 4281 or **ASTM D 562-55 .
Ford	*FTMS 141a 4284 or **ASTM D 1200-70
Fineness of Grind	*FTMS 141a 4411.1 or **ASTM D 1210-64
Drying Times	*FTMS 141a 4061 or **ASTM D 1650-69

*Federal Test Method Standard Number

**Part 27, Annual Book of ASTM Standards, American Society for Testing and Materials

13.3.1.5 The data collected on each batch of material tested in accordance with paragraph 9.3.1.4 shall be compared to the base line data collected in accordance with paragraph 9.3.1.1. Any variance of plus or minus ten percent (10%) shall be cause for rejection of the material. If the material is suspect, the other tests listed in paragraph 9.3.1.1 shall be performed. Any variance of more than plus or minus ten percent (107.) achieved when testing in accordance with the specified procedure shall also be grounds for rejection.

13.3.1.6 Once the material selection has been made against a proprietary formulation, the formulation shall not be changed unless agreed upon by all concerned parties (Shipbuilder and Owner).

13.3.2 Surface Preparation

The condition of the surface achieved as a result of surface preparation shall be inspected for compliance with paragraph IV of the Product Procedure Data Sheet. Failure to meet the specified standard or degree of cleanliness shall be grounds for rejection.

13.3.3 The Conditions and Methods of Application
During and after the application of each coat of paint, attributes as listed on the Product/Procedure Data Sheet shall be checked. Failure to comply with these attributes shall be grounds for noting a variance. Variances shall be brought to the attention of the quality control management for resolution.

13.4 Inspectors

Inspectors shall be fully qualified in the areas of protective coatings and protective coatings application. It is beyond the scope of this specification to define at which level an inspector shall be assigned or through which hierarchy or department he reports. The primary consideration is that controls be documented.

13.5 Vendor Service Representatives

If so specified by the concerned parties (Shipyard/Construction firm/Owner and Material Supplier) the protective coatings supplier may provide the services of a qualified technical services engineer to be present in an advisory capacity at the time of application of any of the products specified under the contract. This individual is not an inspector and should not be used as one.

14.0 PRECONSTRUCTION CONFERENCE

After contract award, prior to the start of production surface preparation and coatings operations, a start-up preconstruction conference will be held between the shipyard production paint personnel and technical representatives, owner representatives and paint supplier(s). The purpose of this meeting is the final specification review and establishment of in-process inspection criteria. As a minimum the following points will be covered.

1. In-process check points.
2. Surface Preparation Standards and Procedures.
3. profile and/or surface roughness measurement.
4. Application Methodology.
5. Paint Sequencing.
6. Material Selection.
7. Role of paint inspectors.
8. Review of the requirements of each protective coating as defined in the Product/Procedure Data Sheet.
9. Definition of sharp edges, removal of burrs, weld spatter, etc.

SECTION 5

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ANNEX A

Recapitulation of Shipbuilder Responses

APPENDIX 1

GUIDE TO PROTECTIVE COATINGS (PAINT) SELECTION

1.0 SCOPE

The recommendations contained in this appendix are believed to be technically sound and current, but are not to be considered as requirements to this standard.

2.0 In selecting the desired protective coating system, a number of points should be remembered. These points are discussed below:

- A. Severity of intended service condition. Listed below, in order of descending severity, are the various general areas of the ship. ,
 - 1. Underwater Bottom
 - 2. Boottop
 - 3. Tanks
 - 3.1 Ballast
 - 3.2 Product (depends on product)
 - 4. Freeboard
 - 5. Exterior Decks
 - 6. Superstructure
 - 7. Exterior Machinery
 - 8. Cargo Holds
 - 9. Machinery Spaces
 - 9.1 Bilge
 - 9.2 Hot Surfaces
 - 9.3 Bulkhead and Overhead
 - 9.4 Decks
 - 9.5 Machinery
 - 10. Living and Working Spaces
 - 11. Dry Voids
- B. Desired design life of the system is an important point. As a general rule, high performance coatings with high initial cost are more cost effective over a time period. However, never select a highly sophisticated protective system without knowledge of all the risks, and only if a less sophisticated system will not fulfill the requirements.
- C. Consideration should be given to primer coats that can protect the steel for extended construction cycles (normally 6 to 9 months) and can withstand abrasion due to handling. Do not use primers which continue to harden with age, such as epoxy ester. Also, primers should be capable of being welded thru, more or less, without liberation of toxic fumes, have fast dry (10 to 20 min.) and be compatible with various top coats.
- D. Ease of maintenance and ease of application. Both of these points must be taken into consideration when selecting a paint system. If the new construction yard and/or repair yard cannot successfully apply the specified material, the entire painting operation is an exercise in futility. For this reason, it is extremely important to review paint vendor supplied Product/Procedure Data Sheets for environmental considerations, special equipment or special skills required prior to making the final material selection.
- E. Another point, water base inorganic zinc should be selected for application in geographical areas of low humidity and alkyl (solvent based) types in areas of high humidity.
- F. Thermoplastic coatings and coatings which harden by solvent evaporation (vinyl, chlorinated rubber, etc.) are generally more easily repaired than thermoset materials (polyurethane, epoxies, esters, etc.).
- G. Health and Safety (see Section 8.0 of Basic Specification).
- H. Be careful in selecting topcoats for inorganic zinc types of material. Do not select topcoats of material from drying oil paints nor modified drying oil paints.
- I. Inorganic zinc paints are generally corrosion resistant from pH 6.0 to 9.5.
- J. Exterior marine coatings are usually exposed to high-intensity ultraviolet light from the sun. Consideration should be given to materials that resist color change and/or chalking under such considerations.
- K. It is becoming common for protective coating suppliers to recommend the combining of different generic types of material within the same system to gain the benefits of both; for example, an epoxy middle coat can be overcoated with various finish coats such as urethanes, vinyl, vinyl acrylics, chlorinated rubber, epoxies and others. Extreme care must be used in this approach. Only materials specified should be used.

3.0 The references listed below may be helpful in making specific protective coatings selections.

Reference

MarAd Paint Performance Study

Source

**U.S. Department of Commerce
Maritime Administration
Washington, DC 20230
AITN: M-920**

**Code of Practice for Protective Coating of
Iron & Steel Structures Against Corrosion,
BS5493:1977**

**British Standards Institution, Publications Manager
101 Pentonville Road, London N19ND,
United Kingdom**

**Design & Corrosion Control
V.R. Pludek**

**Published in USA by Halsted Press, a division of
John Wiley and Son, Inc., New York, New York**

Paints & Coatings Handbook by Abel Banov

**Structures Publishing Co.
Box 423, Farmington, Mich. 48024**

Volumes 1 & 2, Steel Structures Painting Council

**Steel Structures Painting Council
4400 Fifth Avenue, Pittsburgh, PA 15213**

**Corrosion, Volume 2, Corrosion Control,
Edited by L.L. Shreir**

**Newnes-Butterworth, Butterworth, Inc.
19 Cummings Park, Woburn, Ma 01801**

**Corrosion in Marine Environment,
International Sourcebook 1: Ship Painting &
Corrosion; Edited by Derek H. Deere**

**Hemisphere publishing Corporation,
1024 Vermont Avenue, NW
Washington, DC 20005**

**Coating Systems Guide for Hull,
Deck and Superstructure, T & R No. 4-10**

**The Society of Naval Architects and Marine
Engineers, 74 Trinity Place
New York, New York 10006**

**Chapter 16 of Marine Corrosion
by F.L. LaRue**

**Wiley and Sons
New York, New York**

**Understanding Paint and Painting Processes
by Gerald L. Schneberger**

**Hitchcock Publishing Co.,
Hitchcock Building, Wheaton, ILL. 60187**

Ship Painting Manual by A.M. Berendsen

**Barbara A. Chin, RSV (North American), Inc.
20 Exchange Place
New York, NY 10005**

APPENDIX 2

GLOSSARY OF TERMS

Catalysts: Accelerator, retardant or promotor. Causes or retards a chemical reaction.

Curing Agent: Reactant, entering into a chemical reaction with another agent.

Faying Surfaces: The surface area between two metals jointed for structural (building) purposes.

Feathering: Tapered from center to outer edges to achieve a uniform surface.

Hardener: Curing agent, promotor, catalyst, causing a chemical reaction with another agent.

Induction Time: Time required for mixed material to complete initial reaction.

MDFT: Minimum dry film thickness.

Pigment: Substance used to enhance or impart other materials favorable or desired properties.

protective Coating: Coating applied to the substrate for protection from the environment by brush, spray, roller, etc. Can also be used for cosmetic purposes.

Sniping/Striping: Coating of all edged, corners, crevices, bolts, welds by brush prior to first full prime coat.

Solvent Entrapment: Solvent unable to escape (trapped) prior to impervious film formation. Solvent trapped in dry/cured film.

Threshold Limit Values (TLV): Toxicological effect on workmen caused by use of solvents.

Undocked: To launch or make waterborne a floating structure such as a ship.

Recapitulation of all Response

1. Name and Address of Participating Activity:

Instructions: **Unless otherwise noted, a (✓) or (X) should be placed in the appropriate block.**

2. Shipyard environment conditions: (State)

(Hot, Dry, Cold, Wet, Humid, etc.)

3. Shipyard geographical location: N.E. E. Atlantic(b) Mid Atlantic 2(c) S. E. (Atlantic) (d) Gulf 5(e) N. W. (Pacific) 3(f) SOW. (Pacific) 2(g) Inland Waterways 3(h) Great Lakes 1

4. In your steel cycle, at what stage of fabrication is steel cleaned and primed?

	YES	NO	PART	N/A
(a) Purchase preprimed steel plates/shapes	<u>2</u>	<u>T</u>	<u>7</u>	<u> </u>
(b) Clean and prime all steel plates/shapes prior to storage	<u>2</u>	<u>11</u>	<u>1</u>	<u> </u>
(c) Clean and prime all steel plates/shapes immediately prior to fabrication	<u>6</u>	<u>5</u>	<u>5</u>	<u> </u>
(d) Clean and prime steel weldments after fabrication but prior to erection	<u>8</u>	<u>3</u>	<u>8</u>	<u>1</u>
(e) Clean and prime after erection	<u>7</u>	<u>3</u>	<u>5</u>	<u> </u>

5. If you use a prefabrication primer, why?

(a) Steel Corrosion Protection	<u>1</u> <u>0</u>
(b) Provides Cleaner Working Environment	<u>8</u> <u> </u>
(c) Contract Requirements	<u> </u> <u> </u>
(d) Color Code	<u>J</u> <u>-</u>
(e) Other (State) <u> </u>	

6. Do you remove prefabrication primer after fabrication and reprim prior to erection?	YES	NO	PART	N/A
7. Do you remove prefabrication primer after fabrication and erection but prior to final paint/coating application?	1 YES	9 NO	4 PART	3" N/A
8. Initial surface preparation:	YES	NO	ABRASIVE TYPE/SIZE (Stat-i)	
(a) Automatic Abrasive Blasting	13	6	S-50, S-390, S-460 G-40, S-330, S-280	
(b) Manual Abrasive Blasting	8	4	G-230, J-50	
(c) Automatic Power Tool Cleaning	1	9		
(d) Manual Power Tool Cleaning	5	6		
(e) Chemical Cleaning		9		
(f) Other (State) <u>Broom Cleaning to Remove Construction Debris Only</u>				
9. Touch Up Surface Preparation Prior to Final Paint/Coatings Application:				
(a) Automatic Abrasive Blasting	1	11		
(b) Manual Abrasive Blasting	17	2	Mineral Grit, Sand, Coal Slag, 20-40 Mesh.	
(c) Manual Power Tool Cleaning	15	2	Ottawa Silica, Glass Shot	
(d) Hand Tool Cleaning	11	2		
(e) Chemical Cleaning	2	8		
(f) Other (State) <u></u>				
10. Do you "weld thru" Primers	YES	NO	YES, BUT AT REDUCED RATE	
(a) Manual Stick	11	6	2	
(b) SAW	4	13	7	
(c) SMAW	5	13 "	1	
(d) GMAW - Solid Wire	3	13	3	
(e) GMAW - Cored Wire	4	14	1	
(f) Other (State) <u>FAB</u>	2	0	0	

11. Type (s) of primer used?

(a) Epoxy 10

(b) Al kyd 7

(c) Inorganic Zinc 15

(d) Organic Zinc 2

(e) Wash primer 9

(f) Epanol /Phenoxy 1

(g) One Component Epoxy 4

(h) Epoxy Ester 3

(i) Other(State) _____

12. How long will primer last prior to requiring extensive repair?

(a) Three (3) Months 6

(b) Six (6) Months 4

(c) Twelve (12) Months 4

(d) Eighteen (18) Months 2

(e) Twenty-four (24) Months 4

(f) Other(State) _____

13. What is the major cause of primer failure?

(a) Shipyard Construction Damage 11

(b) Paint/Coatings Failure 3

(c) Other (State) Surface Prep., Environment

14. What is the percentage of primer repair prior to finish painting?

1% 5% 10% 20% 4 25% 40% 50% 60% 75% 90% 100%

15. What is the most desired attribute of a primer and why?

Maintain Clean Work Environment, Corrosion Prevention, Weld thru

all welding processes to radiography standards, Topcoat compatibility.

Ease of Application, Fast Dry

16. What is the percentage of preoutfitting prior to module/assembly erection? 0-85%

17. What is the percentage of finish painting accomplished prior to module/assembly erection? 0-90%

18. What is the percentage of total outfitting accomplished prior to launch? 40-100%

19. What is the percentage of finish painting accomplished prior to launch? 15-95%

20. Of the finish painting accomplished prior to erection and/or launch, what is the percentage of repair prior to delivery. 5-40%

21. List in order of importance, the following constraints which impose difficulty on painting/coatings operations. Begin with number 1 as being the most restrictive.

(a) Weather/Environment	<u>2.17</u> (Average)	(e) Quality Assurance	<u>5.11</u> (Average)
(b) Production Interferences	<u>2.17</u> (Average)	(f) Paint/Coatings Specifications	<u>4.24</u> (Average)
(c) Planning	<u>3.56</u> (Average)	(g) Inadequacies of Drawings	<u>6.53</u> (Average)
(d) Difficulty of Paint Materials Application	<u>3.59</u> (Average)	(h) Other (State)	

22. In the following categories of constraints which specific Problems cause interference with painting/coatings application for. your company?

A. Weather:	YES	NO
1) High Humidity	<u>15</u>	4
(2) Low Humidity	<u>.</u>	<u>18</u>
(3) High Temperature	<u>7</u>	<u>12</u>
(4) Low Temperature	<u>14</u>	5
(5) Sudden Rain Showers	<u>16</u>	<u>3</u>
(6) Long Periods of Rainy Weather	<u>10</u>	<u>9</u>
(7) Other (State) Snow, Ice		

B. Production Interferences:

(1)	Interference from Other Crafts	18	1
(2)	Lack of Required Tools/Equipment	1	18
(3)	Lack of Skilled/Trained Craftsman		
4)	Lack of Accessibility to Job	2	11
[5]	Poor Ventilation	12	10
(6)	Poor Lighting	7	9
(7)	Other (State)		

C. Planning:

(1)	Interference from other Crafts	17	7
(2)	No Planned Paint/Coating Activities	8	11
(3)	Work released for finish paint prior to compartment completion	16	-2
(4)	Written process instruction not available to paint..craft personnel	3	16

C. Planning. (con't)

5. Other (State) _____

D. Paint/Coatings Materials:

	YES	NO
(1) Short Pot Life	12	.
(2) Slow Cure/Dry	12	7
(3) Unpleasant Odor	7	12
(4) Low Flashpoint	7	12
(5) Minimum Recoat Time Too Long	12	.
(6) Maximum Recoat Time Too Short	5	14
(7) Lack of Application Instructions	7	17
(8) Application Method Too Complicated for average craftsman	2--	17
(9) Surface Prep cannot be accomplished	4	15
(10) Other (State) _____		

E. Quality Assurance/Control

(1) Written Instructions with inspection attributes are not available to inspectors	5	14
(2) Inspectors are not school trained	6	13
(3) Inspection attributes are purely subjective	5	14
(4) Other (State) <u>personality of Inspectors-</u>		

F. Paints/Coatings Specifications:

(1) Specifications are overly restrictive	5	14
(2) Specifications contains production sequencing requirements which cannot be followed.	3	16
(3) Other (State) <u>SDecifications not compatible with shipyard methods</u>		

G. Paint/Coatings Finishing Schedules:

(1) Incomplete Schedules	15	
(2) Schedules/Drawings difficult to understand	2	17
(3) Other (State) _____		

H. List in order of priority five (5) major shipyard paint/coatings problems/constraints.

1. Obtaining Required Cleanliness Standards

2. obtaining Film Thickness with Specified Number of Coats

3. Elimination of Paint Pinholes

4. Inspectors not trained

5. Specifications Too Subjective

6. Safety Problems

7. Craft Interference

8. Production/Scaffolding Damage

9. Material Application Requirements

10. Accessibility

11. Atmospheric Conditions

12. Blistering in Tanks

Training & Qualif. of Personnel

14. Equipment Down Time

15. Unable to qualify Weld Thru

16. Structural Interferences

YES

NO

23. Does the Coatings/Paint Supplier Provide direct on the job assistance to craft personnel on a routine basis?

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24. QUALITYASSURANCE/QUALITY CONTROL:

(1) Marine Surveyor Inspection	<u>14</u>	<u>5</u>
(2) Owner Inspection	<u>19</u>	<u>0</u>
(3) QA/QC Dept. Inspectors.	<u>15</u>	<u>4</u>
(4) Craft Inspectors	<u>8</u>	<u>11</u>
(5) Craft Supervision Inspection Only	<u>6</u>	<u>13</u>
(6) QA/QC Dept. Audit Only	<u>2</u>	<u>17</u>
(7) Are Inspectors School Trained?	<u>4</u>	<u>15</u>
(8) Are Written Instruction Sheets Used?	<u> </u>	<u>10</u>
(9) Other (State) _____	<u> </u>	<u> </u>

25. Paints/Coatings Specifications And Standards:

(1) Are paints/coatings specifications complete?	<u>13</u>	<u>6</u>
(2) Are paints/coatings specifications overly restrictive	<u> </u>	<u>9</u>
(3) Are paints/coatings standards used?	<u>13</u>	<u>6</u>
(4) Are specifications available directly to craft personnel?	<u>10</u>	<u>9</u>
(5) Which of the following Standards are used?	<u> </u>	<u> </u>
(a) Steel Structure Painting Council Surface Preparation Standards	<u>15</u>	<u>4</u>
(b) National Association of Corrosion Engineer (NACE) Visual Standards for Blast Cleaned Steel	<u>7</u>	<u>12</u>
(c) NBS Certified Coating Thickness Calibration Standards	<u>9</u>	<u>10</u>
(d) Steel Structures Painting Council Paint Thickness Measurements SSPC-PA 2-73T	<u>13</u>	<u>6</u>
(e) The Society of Naval Architects and Marine Engineers Abrasive Blasting Guide for Aged or Coated Steel	<u>4</u>	<u>15</u>
(f) Japanese Standard for the Preparation of Steel Surfaces Prior to Painting	<u>1</u>	<u>18</u>
(g) Pictorial Surface Preparation Standards for painting steel surfaces	<u>9</u>	<u>10</u>
(h) ASTM D 2697 - 73, -Volume Nonvolatile matter in Clear or Pigmented Coatings	<u>5</u>	<u>14</u>
(i) Other: (State) _____	<u> </u>	<u> </u>

26. Please attach any Paint/Coatings Specifications and/or Process Instructions presently being utilized in your operations.

THANK YOU FOR YOUR COOPERATION

ANNEX B

Recapitulation of

Marine Coating Supplier

Responses

CONSOLIDATED LIST

1. NAME and ADDRESS of participating activity:

A. Ameron	E. Exxon	I. Mobil	M. Sigma
B. Briner	F. Imperial	J. M & T	N. Tnemec
C. CarboLine	G. International	K. Napko	
D. Devoe	H. Keeler and Long	L. Porter	

2. What factors should be considered in selecting an optimum paint/coatings system? List as many as you like in order of priority.

See Attached List

3. What, if any, formulation constraints are imposed by raw material properties?

See Attached List

4. What formulation constraints -are imposed by raw material availability and/or cost?

- A. Availability of solvents meeting air pollution requirements.
- B. Toxicological restrictions
- C. Long delivery times
- D. Unavailability of some antifouling toxins such as arsenic and mercury
- E. Cost is a major factor depending on market, % solids in formula and raw material price rises.
- F. Temporary ingredient scarcity; e.g., recent dust shortage.
- G. Availability of resins to formulate 100% solid materials and aqueous coatings with corrosion resistance comparable to best solvent type.

5. In your option, what is the optimum number of coats of paint which should be used in a given paint system?

Three

6. List the environmental factors which should be considered when applying a paint system. Also include a method or standard for measuring a particular factor or condition.

See Attached List

7. What method or standard should be used to measure substrate cleanliness prior to Painting/coating? Visual by owners representative, Japanese SPSS - SSPC Surface Preparation Standards, NACE Visual Standards, SNAME Standards, Swedish Pictorial Standards; white handkerchief.

8. Should a materials qualification testing program be instituted to qualify coating systems for the following ships areas? If so, what standard should be used?

- a. Underwater Bottom
- b. Freeboard
- c. Tanks, Ballast
- d. **Tanks, Potable Water**
- e. Tanks, Clean Cargo
- f. Tanks, Crude
- g. Cargo Holds/Spaces
- h. Engine/Machinery Spaces
- j. Living Spaces

- 7 - yes; 2 - No; 5 - No comment**
- 4 - yes; 4 - No; 6 - No comment**
- 6 - yes; 3 - No; 5 - No comment**
- 4 - yes; 3 - No; 7 - No comment**
- 5 - yes; 3 - No; 6 - No comment**
- 6 - yes; 3 - No; 5 - No comment**
- 2 - yes; 5 - No; 7 - No comment**
- 2 - yes; 5 - No; 7 - No comment**
- 1 - yes; 6 - No; 5 - No comment**

9. Should paint inspectors be qualified/certified to a standard? If yes, what standard/method? 14 - yes; 0 - no; 0 - No comment - No standard presently available. Some vendors provide service; ASTM, NACE presently working on standards.

10. Is blast profile an important factor in paint/coating system performance? If yes, what is the optimum, how can it be measured and to what standard?

Yes - Varies with vendor. Depends on dry film thickness; "optimum is 1/3 of DFT"; no standard presently exists. Keane-Tator Profile comparator; Clemco comparator; SSPC Microscopic method; Profilometer; pull off thickness gauge; select abrasive particle size.

11. How should dry film measurement be accomplished? SSPC-PA-2-Magnetic pull-off gauge; "Manufacturer" method not taking into account profile, "Tooke" gauge.

12. How should film thickness measuring devices be calibrated and to what standard?

SSPC using NBS Standards; ASTM E-376-69

13. How should volume solids be measured and verified? What standard should be used? Inorganic zinc - volatile measurement or wet/dry film (GSA Method) Organic Coatings -

14. What attributes should be measured and verified during application of paints/coatings?

A. Surface Cleanliness	F. Film Thickness (Wet & Dry)	K. Equipment Set-up
B. Profile	G. Dry Times between Coats	L. Quality of Air
c. Temperature and Humidity	H. Ventilation	M. Film Appearance
D. Humidity	I. Holidays (Spark Test)	N. Time before immersion
E. Correct Mixing and Thinning		J. Area Coated
Weight per Gallon	Q. Viscosity	R. Solvent Concentration

15. Should painters be qualified/certified in accordance with a program similar to the welder qualification standards?

12 - Yes; 2 - No; no program available

16. If You could write a specification exactly the way You wanted to, what would be the format? Include generic types and a rational for using each type.

17. Would your company be interested in attending a seminar at Offshore Power Systems sometime in the month of November 1977?
The purpose of the seminar will be to discuss input and goals of the program.

18. Would your company be interested in participating in a materials test program where generic products from different sources are evaluated on an equal basis?

Question No. 2

A. Performance (13)

The applied generic coating system accomplishes the intended result for which it is applied, i.e.:

- (1) Corrosion protection of part, component, area, etc.
- (2) Cosmetics
- (3) Aesthetics
- (4) Increased fuel efficiency

B. Cost (11)

Cost per sq. ft. of applied coating system, calculated over the life cycle of the vessel, includes:

- (1) Initial cost – material consumption using volume solids method surface preparation and application cost.
- (2) Service life – Length of time between initial application and renewal of coating system.
- (3) Maintenance cost — cost incurred repairing and renewing a coating system to a state where it accomplishes the intended performance.
- (4) Increased fuel efficiency.
- (5) Increased vessel availability.
- (6) Cash flow considerations.

C. Application Conditions and Restrictions (11)

Ability to apply the specified coating system under the conditions imposed at the time of application. Includes both initial application and maintenance applications. Some conditions and restrictions are:

- (1) Environmental — Temperature, humidity, and other climatic conditions.
- (2) Equipment availability
- (3) Application skill
- (4) Job planning to include sequence and adequate allotment of time to accomplish correct painting operations.

D. Paint Formula Design (11)

The following points should be considered when selecting/formulating a given paint/coating:

- (1) Environmental conditions under which the paint can and will be applied, i.e., realistic minimum/maximum humidity and temperature.
- (2) Tolerance for film build both minimum and maximum.
- (3) Flexibility of cured material.
- (4) Recoat times — minimum and especially maximum.
- (5) Dry/cure requirements — minimum/maximum humidity and temperature.
- (6) Optimum number of coats of paint within a given system.
- (7) Abrasion resistance.
- (8) Corrosion inhibition.
- (9) Adhesion.
- (10) Application properties — sprayability, brushability, amount and type reducer required, equipment required, etc.
- (11) Compatibility with preapplied, cured coatings. Includes initial system application and maintenance.
- (12) Surface preparation — Type surface preparation required, widest tolerance for less than perfect. Includes initial and more importantly, touch-up and repair.

E. Qualified applicators (4)

F. Maintainability of applied system (3)

G. Availability and quality of vendor supplied, on site technical service (3).

H. Qualified Inspectors (2)

L. Safety (1).

Toxicity and flammability of materials during and after application. Minimum flash points on materials designed for application in enclosed areas.

J. Availability of materials both initially and during overhaul.

K. Financial soundness of vendor (1).

Question No. 3

A. Solvents

- (1) Flash Points.
- (2) OSHA/EPA Emission Limits.
- (3) Drying Times.
- (4) Film Entrapment.

B. Resins/Binders

- (1) Application properties such as viscosity, flow, sprayability, etc.
- (2) Topcoatability.
- (3) Solids Content.
- (4) Susceptibility to moisture, i.e., moisture vapor permeability.
- (5) Chemical resistance.
- (6) Influences film building.
- (7) Drying/Curing times.
- (8) Inherent nature of some polymers impose stringent surface preparation requirements.
- (9) O₂ discoloration and degradation.
- (10) OSHA/EPA exposure limits.

C. Pigments

- (1) Chemical resistance properties.
- (2) Colored pigment limitations for optimum weathering resistance.
- (3) Influences film build.
- (4) Moisture/Water sensitivity.
- (5) Corrosion resistance.
- (6) Inhibition properties.
- (7) Cost (particularly colored top coats).
- (8) Influences film build.
- (9) EPA/OSHA exposure limits.

Question No. 6

Environmental Factors

- A. Air Temperature.
- B. Surface Temperature.
- c. Material Temperature.
- D. Air Velocity.
- E. Relative Humidity.
- F. Dew Point — 2 to 5 degrees within.
- G. Solvent vapor content in tanks or confined spaces.
- H. Local and Federal Emission Laws.
Dust emitted during cleaning operations.
- I. Spray dust emissions, particularly heavy metals.
- K. Direct sun affecting substrate temperature.
- L. SO₂ and chloride ion content.

Method or Standard

- A. Thermometer.
- B. Surface Thermometer.
- C. Thermometer.
- D. Air Flow Meter.
- E. Sling or Electric Psychrometer.
- F. Sling Psychrometer.
- G. —
- H. —
- I. —
- K. —
- L. Drager Tubes.